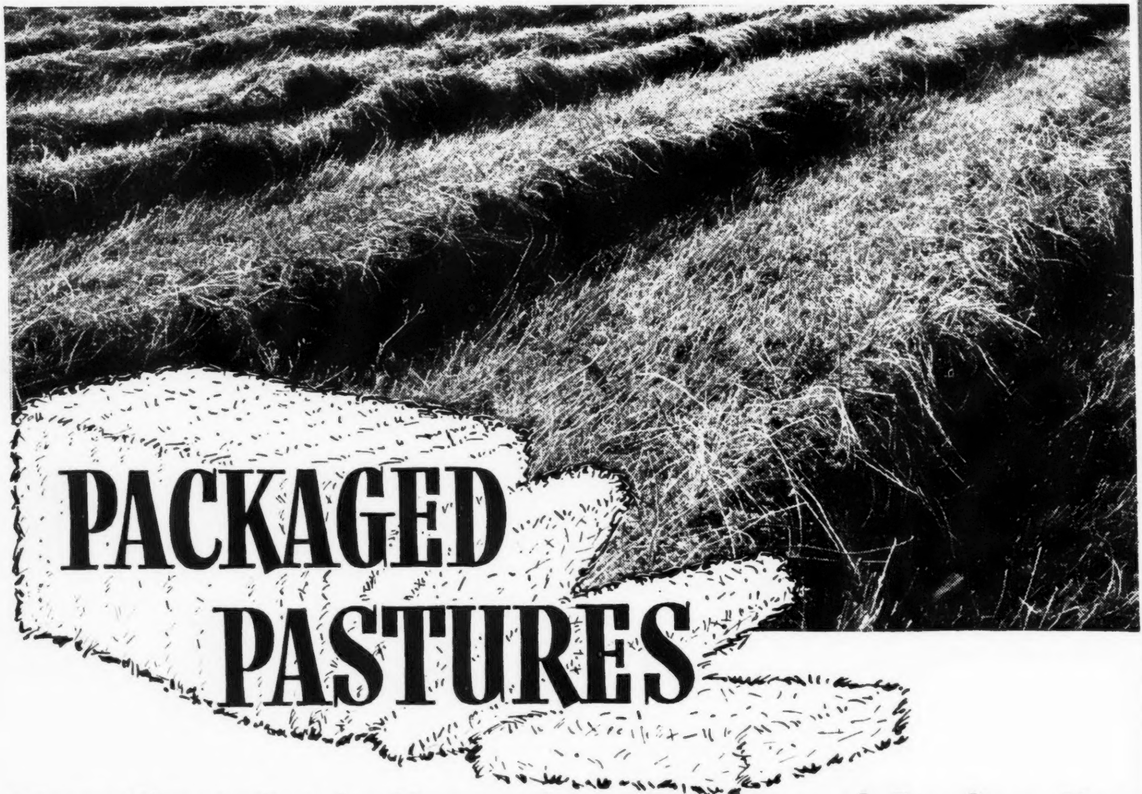
AGRICULTURAL ENGINEERING

SEPTEMBER 1943

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS



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Established 1920

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RAYMOND OLNEY
Editor

RALPH A. PALMER
Associate Editor
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ADVERTISING REPRESENTATIVES

Chicago: DWIGHT H. EARLY
100 North LaSalle St.
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Vol. 24, No. 9

EDITORIAL

Buildings As Producers

ALTHOUGH he nowhere states it in so many words, Mr. Kaiser in the article starting on the page opposite has put eloquent emphasis on the place of agricultural engineering as a distinct and unified profession. He wastes no words on the obvious and oft-uttered advantage of applying engineering to agriculture. Rather, he defines the more elusive part that agriculture in all its infinite interactions must play in our engineering.

The term "functional requirements" for farm buildings has been bandied about as if these requirements could be determined once for all and made a permanent base for engineering ingenuity. He reveals these requirements as purely relative, varying according to the productive level of the animals involved. He dismisses the backward look (how high an investment a certain animal can support) and faces the question "how much does each dollar of a building investment add to net animal productivity, at every level of such productivity and of investment per head."

With this approach, our work will be increasingly interwoven with that of the animal geneticist, nutritionist, and husbandman. It seems obvious that as animals rise to new heights of producing capacity they will be more sensitive to their environment, the conditions which the engineer must create at minimum cost per increment of production. So, too, with crop storage. It will not be the lowest cost at which a bushel of beans can be stored, but the level of storage cost which brings the greatest net gain when the beans are sold or used.

Add to all this the relation with an ever-advancing design of field and building equipment and it becomes apparent that farm buildings do indeed present an engineering challenge. With the changes in farming practice and the decadence of existing buildings, there should be an era of unprecedented activity in our A.S.A.E. Farm Structures Division.

Personal War Profiteers

MERELY as a demagogic device, or as a step toward destruction of capitalism through depletion of capital, the shibboleth "take the profit out of war" leaves us completely cold. We have only contempt for those who would pervert the war effort into an expedient for redistribution of wealth or of revamping the social order which our sons and brothers risk their lives to defend. We defend profits, to the extent that they are taxable, as a fiscal measure. We deplore profits, to the extent that they bloat the bill for the war and particularly as they contribute to inflation.

It becomes increasingly apparent that earnings or profits have little economic effect, and still less social significance, except as they appear in the form of personal purchasing power. Earnings held in a corporation treasury remain a bulwark against depression, a reserve for postwar expansion and employment. Paid out into personal pockets, either as wages or dividends, they put pressure on our supplies of consumer goods and widen the inflationary gap which in some quarters is declared the archdemon of inflation.

As pointed out in these columns some months ago, purchasing pressure on consumer goods comes not from persons accustomed to goodly incomes, but from those whose incomes, large or small, have suddenly increased. This means that our inflation problem is caused principally by persons who are profiting from the war. The logical remedy is to recapture those profits by an excess profits tax on personal incomes regardless of source, whether wages, dividends, professional fees, or farm prices.

Taxation of excess personal profits would ease the burden of war expense on those who are not profiting from the war; mitigate the mounting problems of alcoholism and absenteeism; reduce the load of war debt passed on to posterity by bond issues; and simplify the psychological phase of postwar adjustments. As the most complete and effective device for equalizing the economic impact of war, it should command the support of all who are sincere in their preachments about equality of sacrifice.

All this is of prime importance to the advance of agricultural engineering, particularly in the realm of farm building. Every penny that the dollar is discounted by advancing prices diminishes by one per cent the amount of farm improvement that can be done before the postwar price collapse. And the height from which prices fall determines the degree and duration of the ensuing stagnation in which nothing is accomplished.

Bonds for Rehabilitation

IN THE railroad field, we understand, there is a proposal to provide for "deferred maintenance." War traffic is wearing out rails and rolling stock at a furious rate. Replacement to keep pace with destruction is now neither possible nor in a national sense desirable. Instead of disbursing all of the currently high earnings in taxes and dividends it is proposed to build up reserves definitely earmarked for postwar repairs and replacements.

We profess no wisdom in railway affairs, but we see in the principle of deferred maintenance something eminently desirable in farming. Much of the apparent affluence in agriculture is merely the conversion of capital into current income, liable alike to inroads by the tax gatherer and by diversion to consumer purchases. Depleted fertility, dilapidated buildings, disappearing fences, and wornout machinery all are among the casualties of war unless definite provision is made now for their prompt replacement when materials and labor become available.

To tax as income the amounts which except for the war would be put into maintenance, and which will be needed for rehabilitation later, is palpably unfair; indeed, a capital levy. Not for agriculture alone, but for the sake of postwar employment in the industries and trades which serve agriculture, it would be wise to have reserves available and earmarked explicitly for such rehabilitation and nothing else. By absorbing purchasing power now they would help hold the line against inflation; by providing purchasing power in the critical days to come they would help hold off devastating deflation.

Since practical farmers are anything but accountants, and since six million small units would present an auditing job which might be a bonanza for bureaucrats but a headache for everybody else, it is hardly feasible to provide for such deferred-maintenance reserves in the form of book entries and bank deposits. We offer for consideration as a fairly foolproof device the issuance of special government bonds. They should be non-interest-bearing to preclude their being held as investments. They should be non-negotiable and non-transferable except with the property to which they appertain. They should be non-redeemable until such time as it serves the national interest to release funds for rehabilitation.

(continued on page 314)

The Engineering Challenge of Farm Structures

By W. G. Kaiser

FELLOW A.S.A.E.

As I see it the design and construction of farm buildings presents a problem in engineering of the same magnitude and importance as the development and operation of farm power and farm machinery. Both are intimately related to the enterprise of farming. Both are prime factors in the economical production of food and fiber. Both contribute directly to the efficiency and consequently to the general well-being of the farm people.

I do not hold with some farm economists and farm managers who regard farm structures as a necessary evil to be tolerated. I challenge that type of thinking. It has been proved over and over again that farm buildings, properly designed and built, are an investment which pay real dividends. I shall cite a few cases illustrating how farm structures increase production and consequently farm income.

In 1941 a creamery in central Illinois was obliged to reject 11,000 cans of milk because it soured before it reached the plant. One day in March 1942 this creamery sent back 437 cans of sour milk. Whether this rejected milk was worth $2 a can or $3 a can the loss to the producers was enormous — *and the nation lost much needed dairy products.* Such losses are unnecessary and entirely preventable through the installation of proper sanitary facilities for handling and cooling the milk. Well-engineered dairy barns and milk-houses would have added thousands of dollars to the income of the producers in that one small area.

Earl J. Cooper writing in "The Farm Situation" states that $75,000,000 could be added to dairy income in this country by eliminating causes leading to rejection of milk and cream at receiving stations, and in another article in the same publication Mr. Cooper states that mastitis, a common disease among dairy cattle, costs dairymen of this country $150,000,000 a year in reduced income.

This scourge of the dairymen can now be substantially controlled. Among the control measures recommended is adequate stall space to safeguard the cows against injury. Floors and passageways should be constructed so as to give good footing. To keep down infection floors and stalls must be washed regularly and disinfected. The agricultural engineer can do his part in the control of this disease by designing dairy barns which protect the animals from injury and which are easily kept in a sanitary condition.

Some of you will recall the excellent paper presented by J. L. Strahan before the Farm Structures Division at a meeting of the American Society of Agricultural Engineers in 1927. In that paper Mr. Strahan carefully analyzed the cost of producing milk and proved that the dairyman was economically justified in providing a well-constructed shelter for his herd. This paper will be found in AGRICULTURAL ENGINEERING, January 1928 under the title "Are Farm Buildings an Expense or an Investment?" *It's worth studying.*

A high-producing cow is a highly developed milk-making machine converting feed and forage into dairy products. She must be properly housed to do her best. The dairy sections of this country are mostly in areas where extremely severe winters prevail. The construction of warm, comfortable barns therefore becomes a necessity. In the paper to which I refer Mr. Strahan assumed a cost of $300 to build and equip a stall for one cow in a modern dairy barn. Now Mr. Strahan did not recommend that a farmer spend $300 a cow for a dairy barn. He merely took that figure as a basis for his calculation. Usually a good dairy barn can be built for less than $300 per cow. His figures showed that a good producing cow would have no difficulty in paying off a charge of $30 a year for rental (10 per cent on the stall investment) in such a building.

You will be interested in some figures on the costs of producing milk obtained in a survey made by the agricultural engineering and farm management departments of the University of Missouri and reported by H. B. White in AGRICULTURAL ENGINEERING for June 1931 under the title "The Economics of Farm Buildings". In this study it was shown that only 5.79 per cent of the cost of producing milk is in the service buildings. The items of cost as given were

Interest on investment	5.64 per cent
Veterinary service	0.67 per cent
Pasture	9.08 per cent
Roughage	10.94 per cent
Concentrates	67.86 per cent
Buildings	5.79 per cent

Where farm economists are likely to err in figuring whether a dairy cow can pay the rent on the stall she occupies is that they base their studies on a cow of average earning capacity and place her in a better-than-average barn. Now the average milk cow in the country produces around 150 lb of butterfat in a year, and it is doubtful if that average cow could justify any kind of a shelter. I doubt if she could pay for more than part of the feed she consumes. The sooner such an animal is sent to the butcher's block the better. Her beef ration points would at least have some immediate value.

What I have said about building dairy barns for low-producing cows applies in equal measure to constructing shelters for low-grade swine and poultry. High-producing animals can justify the cost of their shelter; low producers cannot pay for any kind of shelter.

Before leaving the subject of justifying the cost of animal shelters I would like to point out what a relatively small part of a good cow's production is required to pay for her shelter. Let's assume it might cost $300 to provide adequate housing for a good cow. Such a barn should last 50 years, but to be conservative let's assume its useful life to be 25 years, and that the $300 cost per stall is to be completely amortized in 25 years and that interest at the rate of 4½ per cent is to be charged on the unpaid balance. According to standard tables a payment of $1.65 per month would completely amortize $300 in 25 years. This is around 3 lb of butter per month at current prices. This is less than 10 per cent of the production of a cow producing 400 lb of butterfat a year. However, if the cow in this example had produced only 150 lb of butter a year and occupied a stall costing $300, it would have taken 24 per cent of her production to pay for her shelter. On the other hand, if we had based our calculations on a cow producing 600 lb. of butter per year, her shelter cost would have been but 6 per cent of her gross earnings. The conclusion to be drawn from this illustration is that a high-producing cow can easily justify a well-built

The Charmany Farm one-story dairy barn near Madison, Wisconsin, is of all-concrete construction with waylite concrete masonry walls, precast concrete joists, and precast concrete slab roof

An address before the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943.

W. G. KAISER is agricultural engineer and manager, cement products bureau, Portland Cement Association.

shelter whereas a low producer deserves little more shelter than that afforded by a straw stack.

In discussing the engineering phases of a problem it is necessary to stick pretty close to the economic considerations and you will understand why I keep harking back to the item of cost. In some studies on costs made by the division of agricultural economics of the University of Minnesota and reported by H. B. White and L. W. Neubauer in AGRICULTURAL ENGINEERING for January 1934 under the title "Farm Building Costs and Labor Earnings", it was found that dairy farms having the largest investment in service buildings also had the highest labor earnings. The high ten farms in the dairy group showed that for an additional $401 annual cost of buildings there was an increase in labor earnings of $1,134.

It might appear that I am advising huge expenditures for farm buildings. That is not the case. I am merely trying to point out that adequate buildings are as essential in the efficient production of farm products as up-to-date equipment is in the factory for producing manufactured goods.

So far I have not touched on the labor-saving possibilities of a carefully designed dairy barn. Labor requirements for dairy husbandry are known to be high. I have seen reports indicating labor requirements as high as 200 hr per cow per year. The average is perhaps somewhere around 150 hr per cow per year.

An efficiency engineer, in looking for ways to cut dairy production costs, would look twice at the high labor requirement and would immediately see if something could not be done about reducing that item of expense. And it can be done. Permit me to cite you a specific case.

A Boone County, Missouri, dairyman (See "Capper's Farmer" for May 1939: "Sanitary Dairy Unit", by Geo. Armstrong) with the assistance of the Missouri college of agriculture redesigned and rebuilt his dairy unit to meet the requirements of the local milk ordinance. Soon after the new plant was completed the owner cooperated with the dairy department of the college in making a study of the time required for milking in this plant as compared to the time consumed in a standard dairy barn. Only 5.7 min a cow was needed in the new plant, while the average for the other barn was 7.8 min, or a saving of 71 min a day for his herd. Most of the time saving was due to the more compact working space.

And another specific case. My associate, E. L. Hansen, visited a farm near Rockford, Illinois, last week at which some remodeling of a dairy barn had been done and a new milkhouse had been erected adjacent to the barn. This location saved time formerly required to haul milk to a more distant milkhouse. By facing the cows out in the barn he was able to back the spreader into the litter alley to clean out the stalls. This farmer is convinced that the new setup saves him at least 1 hr a day.

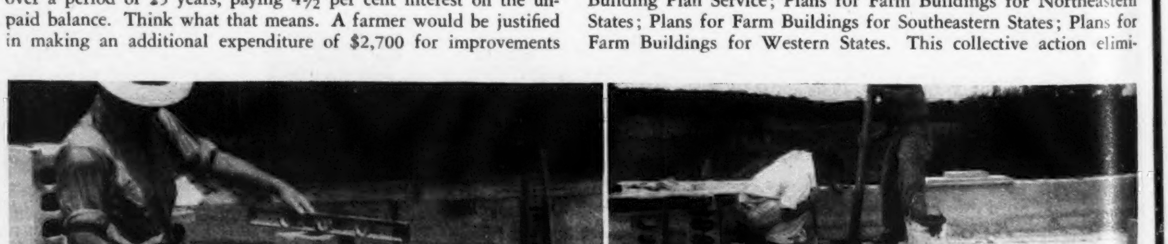
Any time saved should have a real dollar and cents value, particularly in these times of labor shortage. The saving of 1 hr a day at 50c an hour will completely amortize a building costing $2,700 over a period of 25 years, paying 4½ per cent interest on the unpaid balance. Think what that means. A farmer would be justified in making an additional expenditure of $2,700 for improvements having a useful life of 25 years whenever the use of such improvements would save an average of 1 hr a day.

The engineer is beset with many problems in designing suitable farm structures. Probably his greatest handicap is the absence of a common understanding of the conditions which must be fulfilled by the completed structure — that is, what are the optimum conditions of temperature, light, space requirements, relative humidity, and so on for dairy cattle, beef cattle, hogs, sheep, and poultry. I grant that there is no lack of ideas, often very divergent ideas, as to what constitutes the best environmental and other conditions, but what we agricultural engineers most need now is a common agreement among agricultural authorities on these factors. Once the functional requirements are definitely stated the problem of design and construction becomes relatively easy. Engineers know enough about structural materials to design a building once the basic requirements to be met are specified.

There are many inconsistencies in available data and farm building plans but not more than was to be expected when the origin of most farm building plan services is considered. I speak from experience for I was in at the start of organizing such a plan service at one of the state colleges. I was a raw recruit just having received a bachelor of science degree. I had lived on a farm and knew something about the practical needs of farm buildings. I had acquired some knowledge of the use and strength of construction materials in my college course but frankly there was a whole lot of information that was not available to me. I did what I expect every other novice would do under similar circumstances and that is collected all the bulletins I could find on the particular farm structure on which I was working at the time and took a sort of general average of recommendations, some of which probably were obsolete at the time, and mixed these with several parts of my own ideas and created a new design for a farm structure — a sort of a hybrid you might call it.

Many farm building plans have had their origin in the mind of some farmer who wrote in to his state college for special plans to meet his requirements. When completed these looked pretty good to the designer and were added to the plan service. Is it any wonder then that there are more than 500 designs for poultry houses in the various plan services in this country. Is it any wonder that adjoining states having almost identical climatic conditions would be found recommending poultry houses that were about as different from each other as two poultry houses could be. The situation with regard to other farm building plans is in about the same general state of confusion. I suspect that an honest confession from the men here representing farm machinery, farm power, land utilization, and other phases of agricultural engineering would reveal no better state of affairs in their chosen line of specialization.

Now a great deal of progress was made in the direction of standardizing farm building plans when groups of colleges through their agricultural engineering staffs pooled their best plans and formed regional plan services, as, for example, the Midwest Farm Building Plan Service; Plans for Farm Buildings for Northeastern States; Plans for Farm Buildings for Southeastern States; Plans for Farm Buildings for Western States. This collective action elimi-



(Left) Laying wall of concrete blocks in the construction of a hog plant • (Right) Placing concrete for one of the longitudinal beams supporting the concrete roof of the one-story Charmany Farm dairy barn. The ends of the precast joists project into the beam and the concrete roof slabs are laid over the joists. The roof slab is finally covered with a tar and gravel application to make it watertight

A view of the efficient hog production plant on the Hans Hansen farm near Cordova, Illinois

nated many of the inferior plans. There continued to be many inconsistencies in design factors. These regional plan services provided plans but gave the designing engineer little information on basic or functional requirements of the several farm buildings, information which he needed in preparing suitable plans using any one or a combination of a number of construction materials. The big trouble with a standard plan is that it is likely to illustrate the use of but one construction material whereas there may be a number of other materials equally suitable for the purpose. In other words, standard plans were often inadvertently unfair to those construction materials not indicated on the drawings.

Recognizing that little further progress could be made in improving farm structures until a set of basic functional requirements for the principal farm buildings was developed, a group of agricultural engineers representing the building materials interests tackled this job. It has initiated work whereby the U. S. Department of Agriculture in cooperation with state colleges has undertaken a program to develop functional requirements. At the present time a national report on the functional requirements of hog houses has been finished and is ready for printing. A similar report on the functional requirements of dairy barns is nearing completion to be followed by reports on other major farm structures. These should be of inestimable value to farm structures designers. They will not be the last word on the subject as they represent but a cross section of the best thought that is available and there is considerable difference of opinion among recognized authorities. In some cases it is obvious that a program of research will have to be undertaken before the desired information will be available. It is probable that it will neither be possible or desirable to define too closely what the basic functional requirements of a farm building are. In the design of animal shelters is it not possible that the animals can adapt themselves to quite a wide range of environmental conditions? What the range is again we don't know — a further challenge to the researcher and designer of farm structures. Functional requirements are not static and the setting up of fixed standards might militate against originality or improvement in design. Most certainly the agricultural engineer would not want that situation to occur.

I have been actively engaged in some phase of farm building design and/or construction since 1914. I trust that my 29 years of work in this field has not resulted in my acquiring too fixed ideas concerning the functional requirements of farm buildings or of the materials used in their construction. During that time I have witnessed many changes in farm building design and construction. Compare the dark, smelly, unsanitary dairy barns of 30 years ago with the clean, sweet, modern dairy barns of today and you get what I mean. The horse barn of yesteryear often the most impressive service building on the farmstead has largely yielded to the machine shed of today. The design of grain storage bins is receiving a great deal of attention necessitated by the changing methods of harvesting and by the need to provide storage for longer periods on the farm. The half and full monitor roof type hog houses and poultry houses which were so common 20 to 30 years ago are vanishing from our farm landscapes. They were cold, drafty, expensive and deserved no better fate than has befallen them. What about the dairy barn with the voluminous hay loft? Is it on its way out through wider use of grass silage, chopped and field baled hay? In other ways farm structures are constantly undergoing change. There probably will not be any miraculous changes in design and construction. Progress in the design of farm structures is evolutionary, not revolutionary. Many changes will be brought about but they will evolve as a gradual transition.

Today as you travel across the countryside numerous new small poultry houses and hog houses may be seen. Almost every building material dealer's yard has a stock of them. The question might well be raised: Are these small structures indicative of a trend away from the larger fixed structures to small movable buildings? In my opinion this situation is the result of temporary conditions and is a matter of expediency with the farmer. He needed additional housing facilities to meet the increasing number of hogs or chickens he was raising in order to meet food production goals. He did not have the time and often could not get the materials to build larger structures. Moreover, he was not certain that he would need the additional facilities for shelter after the war and so invested in temporary equipment. Building material dealers, too, have had a lot to do with this situation. They saw an opportunity to make a profit in working up stocks of lumber and selling it as completed buildings. I regard the increase in these small structures primarily as a temporary expediency to provide supplemental housing for the duration. Now that is my opinion. Time will tell whether I am right or wrong.

Again we hear and read a great deal about prefabrication and how it will revolutionize construction methods. Prefabrication will increase but I do not anticipate any startling amount of prefabrication. I doubt if it will go much further than to the making of panels, sections, door and window assemblies, etc. The labor unions intend to unionize these shops, and with equal or higher labor cost in the shop compared with that in the field, the shop method will be working under a handicap. This applies more particularly in farm construction since in normal times a farmer and his sons or his hired help do a great deal of the construction work at a low out-of-pocket expense.

The war, particularly the food production program, has focused attention to the need and value of farm buildings as has never been the case heretofore. The need was felt primarily because of insufficient shelter for the increasing numbers of farm animals and lack of suitable storage space for farm crops. Unquestionably farm production is being markedly impeded by lack of adequate farm buildings. In support of this statement I would like to quote a few brief extracts from an article in "Farm Journal and Farmer's Wife" for July 1943. This article under the heading "Deplorable", gives some of the results of a survey made among 10,000 farmers by Purina salesmen, for example: "50 per cent of poultry flock had insufficient housing space; 15 per cent of the herds of swine had no farrowing houses; 17 per cent did not have enough farrowing pens, the pens were too small in 23 per cent of the cases." If this country falls short of its goal in food production it may be due as much to inadequate farm buildings as to bad weather conditions or to the lack of farm machinery.

A less direct but nevertheless tremendous loss is being sustained by farmers because structures do not meet standard sanitary requirements to safeguard the health of the animals and to protect farm products from deteriorating or becoming worthless before reaching the market. Then too there is the further loss on account of the inefficiencies in the planning of the related buildings which results in much loss of precious time. Many farm improvements like paved feeding floors for hogs and cattle more than repay their cost with each year's use through feed saved, greater poundage of beef and pork produced, improved health of the animals, and the saving of labor for the farmer. It is in times like these that the value of farm improvements as a means of producing and conserving food is realized.

What about the postwar situation for farm buildings? For twenty years or more farm buildings repair and construction has not kept pace with wear and tear, depreciation, and obsolescence. With anything like parity prices *(Continued on page 292)*

Prefabricated Grain Bins for Emergency Storage

By H. J. Barre

MEMBER A.S.A.E.

THIS paper discusses the different types of prefabricated grain bins purchased by the Commodity Credit Corporation during the summer of 1942 for the storage of large quantities of wheat throughout the Midwest. The Farm Structures Research Division of the former Bureau of Agricultural Chemistry and Engineering assisted in the procurement of the bins through the preparation and checking of plans and specifications. Also, inspections of the bins were made at a large number of the prefabricating plants and in the field.

Early in May 1942 the Department of Agriculture decided to purchase prefabricated wood bins to provide storage for more than 100 million bushels of wheat. The bins were purchased by the Commodity Credit Corporation and either sold to farmers or used by the Corporation itself for the storage of wheat in those areas where storage was badly needed. The problem of providing this amount of storage during the time available was complicated by the following conditions:

1 There was not enough lumber and nails in local lumber yards to provide even an appreciable part of the storage needed in many of the localities.

2 The restrictions placed by the freeze order on lumber in May 1942 made it difficult for local yards and fabricators to obtain lumber.

3 A large number of contractors located in widely separated localities were required to obtain the volume of production necessary to supply bins for this amount of storage.

4 Experience with prefabricated wood grain bins of the type desired was lacking almost entirely.

In view of the emergency situation and in view of the inability to obtain the desired number of bins on a single set of specifications, it was decided that the bins be contracted for on a negotiable basis. The contractors were called upon to submit their own designs and specifications. These were checked for strength and other important requirements. This procedure was considered desirable because many of the contractors had had considerable experience in prefabrication of houses in connection with defense and war activities. It was thought also that prefabricators would be able to supply new ideas and designs which would contribute to the construction and serviceability of the bins. However many of the new ideas so submitted were considered impractical under the circumstances.

A paper presented at the fall meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1942. A contribution of the Farm Structures Division.

H. J. BARRE is agent in charge, grain storage investigations, farm structures research division (BPISAE, ARA), U. S. Department of Agriculture.

Certain requirements were considered essential in these bins considering the manner in which they were purchased and the purposes for which they were to be used. Those considered most important are as follows:

1 *Demountability.* In order to be able to ship them from the fabricating plant to their destination and possibly at a later date transfer the bins from one area to another, it was desirable to have the bins supplied in demountable sections.

2 *Cost.* The unit cost of the bins had to be comparable to that of conventional types in use on farms.

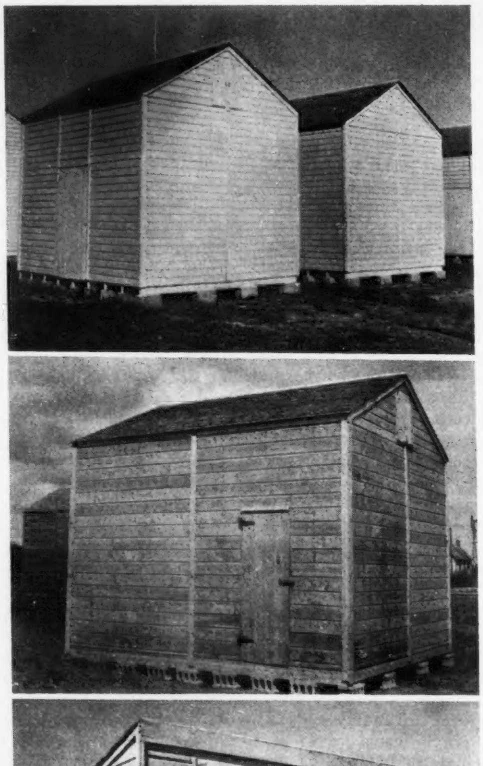


Fig. 1 Typical prefabricated sectional wood grain bins • (Top) A group of 12x16x10-ft bins. The capacity of each is 1600 bu • (Center) A 14x16x10-ft bin with a capacity of 1860 bu. Many bins of this type were supplied with an 8-ft section added to the right end of the bin, making it 24 ft long and giving a capacity of 2790 bu • (Bottom) An 8x16x-8-ft shed roof bin with a capacity of 820 bu

3 *Salvage and Other Utility Value.* The salvage value and the possibility of using the bin for other purposes were considered highly desirable.

4 *Ease in Erection.* The ease with which bins could be erected in the field with unskilled labor was given much weight. Also, methods of construction which eliminate or lessen the chances for error in erection were considered highly desirable.

5 *Other Requirements.* Careful consideration was also given to other requirements including filling doors, headroom for inspection and sampling, and provision for ventilation. Filling doors were supplied in both gable ends in most bins. While these are not as satisfactory for filling with a portable elevator as hatches in the roof, they can also be used for limited ventilation if necessary. Full-height doors were supplied in most bins, especially in those which might later be used for other purposes. In some of the larger bins to be used only for grain storage, a 2x2½-ft door for emptying and access to the bin was supplied.

Nearly all the bins were built with sufficient pitch to give at least 4 ft of headroom for inspection and sampling of the grain. In the bins with a flat roof, additional wall height was added to give the desired headroom.

No special provision for ventilation was made because only dry grain was to be stored in the bins. However, the doors in the gable ends may be opened slightly to provide a limited amount of ventilation which is considered necessary only in case high-moisture grain exists in the upper layer as a result of leaks or accumulation of moisture. Therefore, the doors were hinged at the top to prevent ordinary rains from blowing in when slightly open.

A number of different types of bins were purchased. In the early stages of negotiation only the rectangular type of bin was considered, since this type was generally preferred.

Prefabricated, Rectangular, Sectional Bins. By far the largest number of bins purchased were of the prefabricated, rectangular, sectional

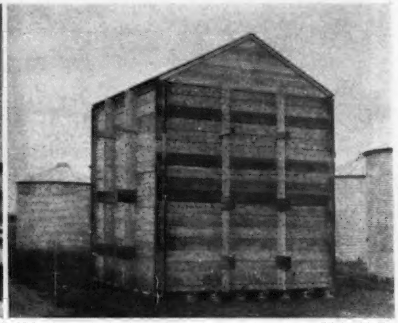


Fig. 2 (Left) A 1600-bu precut wood bin. The dimensions are 12x16x10 ft • Fig. 3 (Right) A bin of tongue and groove wood planks. Notched horizontal ties and uprights provide the necessary strength to resist the grain pressures. Nails are required only for roof and floor. Dimensions, 14 ft 9 inx14 ft 9 inx17 ft. Capacity, 2950 bu

type, with capacities ranging from about 600 to 2800 bu (Fig 1). Common sizes were as follows: 8x12x8, 10x16x8, 12x16x10, 14x-16x10, 14x20x10, and 14x24x10 ft. A number of precut bins (Fig. 2) were also supplied.

After a preliminary study of the sizes of bins to be purchased, it was found that by increasing the height from 8 to 10 ft a saving of about 2c per bu of capacity could be effected. Early quotations by different contractors were rather high, ranging from 19 to 30c per bu of capacity. The first contracts for wood bins were completed at about 12c per bu at the fabricator's plant. Freight costs on units varied considerably, but in most localities these ranged from 1 to 2c per bu, providing the distance of shipping did not exceed 500 miles. In other words, bins of this type were delivered at shipping points at a cost of about 14c per bu.

Later a number of designs and plans were prepared in an attempt to obtain some uniformity. As a result, about four or five such plans of rectangular types of bins were prepared. However, specifications for bins, even with the same design, were varied considerably to meet local conditions, including kinds of wood, grades of lumber, and certain framing details.

The earlier designs did not provide for sufficient ties to prevent noticeable bulging. Some of the first bins were filled experimentally with grain to determine what additional ties or braces were needed. Adequate tieing and bracing were considered especially important in bins to be located along railroad sites where vibration from passing trains subjects structures to greater stresses. The likelihood of uneven settling of the temporary foundations of masonry blocks also produces greater stresses. In general, cross and longitudinal ties of 2x6's and 2x4's were supplied at a height of about 6 ft above the floor. In some of the larger bins, especially those in which the floor panels were not fastened together securely, ties were also supplied 4 ft above the floor.

A surprisingly large number of nails is required for this type of bin. For example, in the 12x16x10-ft bin about 85 lb, and in the 14x24x10-ft bin 110 lb of nails were required.

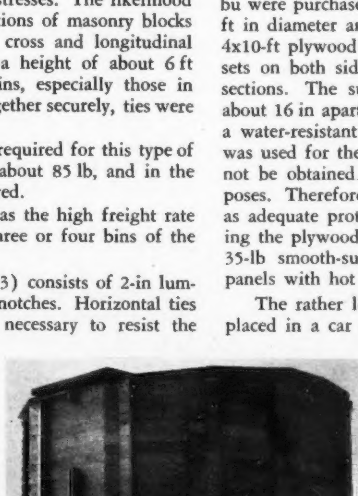
One disadvantage of this type of bin was the high freight rate and large shipping space required. Only three or four bins of the larger sizes could be placed in a car.

Wood Plank Bin. The plank bin (Fig. 3) consists of 2-in lumber fastened at the corners through simple notches. Horizontal ties and uprights provide the added strength necessary to resist the pressure of the grain. The planks were cut to a tongue and groove pattern to provide weathertight joints. This method of construction permitted the use of green lumber, since any shrinkage in the joints was overcome by settling of the wall, especially when the bin was filled with grain. The cost of this bin was about 12c per bu. Although 2-in lumber is used for the walls and floor, the board feet of lumber per bushel of capacity for this size of bin is not appreciably greater than that for the prefabricated sectional bins. The freight rate on a bin of this type is also much lower, being the same as that for lumber. The planks in this bin can be readily salvaged for other uses.

Wood Stave Bin. Wood stave bins (Fig. 4) of short 2-in planks were obtained for storage in the Northwest. The diameter is 18 ft and the height 16½ ft. It has a capacity of 3340 bu. The principal advantage of this type of bin is that it can be made of short-length lumber. As in the case of the wood plank bin, shrinkage of the staves presents no problem. The lengths of the staves are 6 and 8 ft. The bin has twelve sides. There are twice as many 6 ft as 8 ft staves, which is about the same proportion when cut from random lengths of planks. While the staves are precut and dressed, the freight rate is the same as for lumber. The flooring is also of 2-in planks. A flat roof appears to be the most practical for this type of bin, although the wall has to be made about 18 in higher to provide sufficient headroom for inspection and sampling.

Plywood Bins. Plywood bins (Fig. 5) with a capacity of 2250 bu were purchased from two different contractors. The bins are 19 ft in diameter and 10 ft high. The wall panels consist of 5/16-in 4x10-ft plywood sheets glued at the joints with 4-in plywood gussets on both sides. The roof was likewise made in prefabricated sections. The supporting members consist of 1x3 rafters spaced about 16 in apart at the base of the roof. Douglas fir plywood with a water-resistant glue of the type used in concrete form plywood was used for the walls and roof. Plywood of exterior grade could not be obtained because of its demand for war and defense purposes. Therefore the painting of this plywood was not considered as adequate protective covering. The best compromise for protecting the plywood against weather appeared to be the application of 35-lb smooth-surfaced roll roofing glued to the wall and roof panels with hot asphalt.

The rather low freight rate and the fact that 15 bins could be placed in a car for shipment were considered to be advantages of



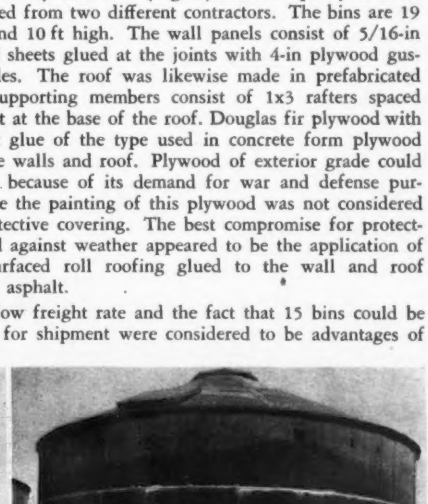
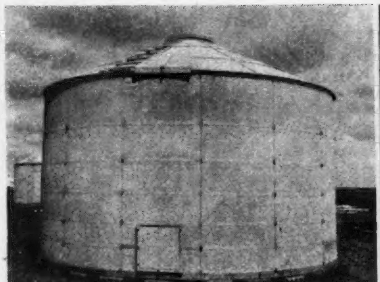
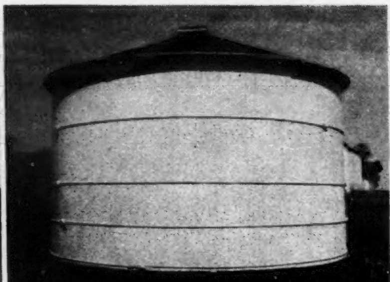


Fig. 4 (Left) A 12-sided wood stave bin. The staves which are of 2-in tongue and groove planks are 6 and 8 ft long. Floor is also of 2-in planks, tongue and groove. Roof consists of roll roofing laid over wood sheathing. Diameter, 18 ft; height, 16½ ft; capacity, 3340 bu • Fig. 5 (Right) A circular grain bin with walls and roof made of plywood glued at the joints and covered with roll roofing to give weather protection. Lightweight steel bands have been supplied to this bin for added strength. This precaution has been taken on a number of bins to overcome weaknesses due to defective glued joints. Diameter, 19 ft; height to eave, 10 ft; capacity, 2250 bu





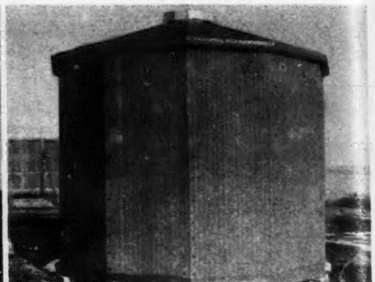


Fig. 6 (Left) A grain bin with walls and roof of ⅜-in insulation board. Wall panels are 4 ft wide and 10 ft high and consist of two thicknesses of board with a ¾-in air space between. Roof is made of several sections with two laminations. Floor is of wood laid on 4x4-in joists. Light bands are supplied to take care of the hoop tension. These are bolted at wall panel joints. Diameter, 19 ft; height to eave, 10 ft; capacity, 2250 bu • Fig. 7 (Center) A circular grain bin of matched vertical siding. Steel hoops are supplied to resist the grain pressures. Diameter, 15 ft; height, 10 ft; capacity, 1700 bu • Fig. 8 (Right) A 12-sided prefabricated bin. Floor, wall, and roof are all in prefabricated sections. The walls consist of matched vertical siding over 1-in sheathing. Diameter, 14 ft; height, 10 ft; capacity, 1300 bu

this type of bin. Further, the cost of about 12c per bu made it rather economical. This cost included a wood floor laid over 4x4 joists.

A number of failures of this type of bin have occurred in the field. This was due to faulty gluing of joints made either at the fabricating plant or in the field. A number of tests made on these joints indicated that they could be improved considerably by using better gluing techniques and by using nails spaced about 4 in apart near the edge of the gussets.

Further developments on this type of bin are being made with a view of overcoming some of the principal objections. One of these is a field joint requiring no gluing in the erection of the bin.

Bins of Insulation Board. A number of bins (Fig. 6) constructed of ⅜-in insulation board have also been purchased. The cost of these is low in order to make it possible to compensate in part at least for some of its disadvantages, in that the material has very little strength and resistance to shock and penetration. The material was also less critical than the wood used in a large number of bins. Steel bands were supplied to take care of the hoop tension.

A few types of prefabricated bins which previously had been distributed through regular commercial channels were also purchased in limited quantities. These included bins of a circular type (Fig. 7) reinforced with steel hoops and a 12-sided panel bin (Fig. 8) the walls of which consist of matched vertical siding over 1-in sheathing.

Experimental units of other types of bins proposed as suitable for the storage of grain were built and filled at the different experimental grain storage sites to determine their suitability for grain storage. Test bins with improvements to overcome certain weaknesses, as well as bins to demonstrate the feasibility of substitutes for siding and roofing, have also been erected and filled and are now under observation.

The Engineering Challenge of Farm Structures

(Continued from page 289)

for farm products after the war I can foresee a tremendous expansion in farm building construction. The desire to build is there; the need is real and urgent and funds will be available to do the work. The big question which we as agricultural engineers should ask ourselves is can we supply the technical services which will enable the farmers of this country to build structures which are correctly engineered — buildings that will satisfy the functional requirements and that will be economical and efficient?

My subject is the engineering challenge of farm structures yet I find myself challenging the engineers who are largely responsible for the design of better farm structures. If we do not accept that challenge, who will? Farm structures has been the step-child of the construction industry; the architectural profession is seldom called in to design farm buildings. There are no building codes or regulations to govern farm construction — no inspection to insure structural soundness. There is no financing organization like the Federal Housing Administration which exercises a certain supervisory control over design and construction.

Every farm structures engineer knows how desperately the farmer needs technical assistance. Again let me refer to a recent observation of my associate, Mr. Hansen, to illustrate this point. A new hog house was being erected near St. Charles, Illinois. The workmen were doing an excellent job of building. The hog house looked very impressive to the casual observer but on close examination it was found that the ceiling was 16 in higher than necessary. This meant greater construction cost, also a building which would be harder to maintain in a comfortable condition in cold weather. Another serious mistake was that the floors were made to slope from the feed alley to the outside which is bound to result in wet bedding and unsatisfactory farrowing pens. This farmer would have been money ahead had he employed a competent farm structures engineer to design his hog house.

Time does not permit me to cite other cases but you will agree I'm sure that the need for giving farmers technical advice in their construction problems is real and urgent.

The engineering problems of farm structures challenge the best brains in our profession. I shall attempt to enumerate some of the qualifications for a competent farm building designer:

1 The farm structures engineer must have an intimate knowledge of the functional requirements for each of the different farm structures — hog houses, poultry houses, dairy barns, grain storage bins, and so on. Each type of building has a distinctly separate set of requirements.

2 He must be familiar with the different materials of construction which are available for farm construction. He should know how to use them to best advantage separately and in combination with each other. He should know approximately what it will cost to fabricate the materials on the building site.

3 He must be capable of undertaking structural design. Some of the design problems confronting the farm structures engineer are complex and indeterminate requiring a knowledge of structural design. If he has some architectural training in addition so much the better.

4 The farm structures engineer must keep his ear attuned to the constant changes which are taking place in agriculture.

5 He must have some of the qualifications of a farm manager to understand the relation of the different farm buildings and plan them with a view to saving labor.

6 To sum up, the farm structures engineer must be a jack of all trades. He must qualify as a structural engineer, as a sanitarian, as a farm manager, often as a livestock or crop specialist.

And now a final word. Farm structures present an engineering problem and challenge of the first magnitude. How well we accept that challenge now and in the future is strictly up to us. In my opinion the American Society of Agricultural Engineers has before it a golden opportunity to assume leadership in rendering a real service to agriculture through the improvement of farm structures. More than a passive interest is needed to do the job.

Labor Duty in the Harvesting of Ensilage

By J. B. Davidson, C. K. Shedd, and E. V. Collins
FELLOW (CHARTER) A.S.A.E. FELLOW A.S.A.E. MEMBER A.S.A.E.

THE preservation of succulent crops by storage in airtight structures is a practice more than a century old. The early silos used in southern Europe were, for the most part, little more than pits into which green forage could be packed with but little if any preliminary processing. In the United States, beginning about 1850, the type of silos constructed was changed until a large part of the structure was aboveground. This trend in the type of structure continued until silos of considerable height were built. These structures aboveground made the removal of ensilage comparatively easy, as it was only necessary to fork or rake the feed out of a door, usually extending continuously up and down one side, and let gravity carry it down to the feeding cart or conveyor.

The aboveground silo made it necessary to chop the forage so that it could be easily conveyed up into the silo by an elevator of the chain and flight type or of the blower type. Chopping also facilitated the packing of the silage and made its removal easier.

Although silos have continued to be considered more or less essential equipment for the feeding of dairy cows their use in other than strictly dairy farming sections has passed through alternating periods of popularity and decline. This is particularly true in certain sections of the corn belt where the corn crop furnishes forage admirably suited to storage in the silo. It would appear that all authentic feeding information indicates that corn ensilage is a valuable feed for all breeds of cattle and sheep. Many livestock men continue to be enthusiastic for ensilage as a feed, indicating that there must be good reasons for the apparent decline in the use of the silo.

A cursory study of the silo situation indicates that filling a silo under the usual conditions represents a real labor problem which many farmers would like to avoid. The usual plan of operation, consisting of the cutting of the corn in the field with a corn binder, loading, hauling, and feeding to the stationary ensilage cutter, involves under the usual prevailing conditions a large force of men and much of the work is very arduous. The operation frequently calls for the exchange of labor. This can be best arranged when the cooperating farmers are on about the same basis as to the amount of work to be exchanged. Farmers who have a small crop to place in silos do not care to cooperate with farmers having a large crop to handle. Extensive farmers having several silos and a sufficient force of workmen, get along somewhat better because they are in a measure self-sufficient. At any rate the situation is such as to appear to make the harvesting of ensilage an inviting field for agricultural engineering research with the rather specific objectives of reducing the labor required, changing the character of the labor, and reducing the cost of harvesting.

Studies in the harvesting of ensilage were started at the Iowa Agricultural Experiment Station in the fall of 1940. The preliminary work consisted in making an analysis of ensilage harvesting as practiced on the college farm to determine the amount and distribution of labor. It would have been better in some respects to have used as a basis or starting point an analysis of the ensilage harvesting enterprise as practiced with teams for hauling wagons and pulling the corn binders. Instead the first studies were made with all operations carried out with tractors, which undoubtedly required less labor because less time was used in hauling.

Table 1 gives the labor used in harvesting ensilage with corn binders and a stationary silo filler. These data should represent conventional practice. The crew worked hard and the output was considered average. The distribution of the labor indicated where some improvement could be made. It is to be noted that 53.7 per cent of the labor was used in loading the forage, and at the same time this labor was very arduous. It can be pointed out that a part of this labor could be saved by equipping corn binders with elevators to carry the bundles of fodder on to the wagons as they are drawn beside the binders. As silo filling is generally practiced, however, the binders are operated in advance of the loading.

TABLE 1. LABOR USED IN HARVESTING ENSILAGE WITH CORN BINDER AND STATIONARY SILO FILLER

Equipment	Number of men
Cutting—single-row corn binder pulled by small tractor	1
Hauling—three trailers pulled by three tractors	3
Loading	5
Feeding—in addition to haulers	1
Length of haul, 0.4 mile	

Labor*	Man-hours per acre	Man-hours per ton	Man-hours per cent
Cutting	.8	.08	3.7
Loading	11.7	1.11	53.7
Hauling and unloading	7.0	.66	32.1
Feeding	2.3	.22	10.5
Total	21.8	2.07	100

*Does not include two men in silo distributing and tramping ensilage.

After the preliminary studies, a field harvester was substituted for the corn binder and a blower for the silo filler at the silo. Table 2 reports the labor used and the equipment and operations performed. The distribution of the crew and the labor required for each operation is reported.

TABLE 2. LABOR USED IN HARVESTING ENSILAGE USING A FIELD ENSILAGE HARVESTER

Equipment	Number of men
Ensilage harvester drawn by tractor	1
Hauling—4 trailers 7x14 on rubber tires	
1 tractor to pull trailers while loading	1
2 1½-ton trucks carrying load and pulling trailer	2
Unloading—Blower operated with tractor	5
Length of haul, 1.5 miles	

Labor*	Man-hours per acre	Man-hours per ton	Man-hours per cent
Harvesting	1.7†	.13	11
Hauling	5.1	.39	33
Unloading	8.5	.65	56
Total	15.3	1.17	100

*Does not include two men distributing and tramping ensilage in the silo.
†Owing to the lack of coordination the harvester was not kept busy.

It was observed that 24 per cent of the time of unloading was used at the blower in the change of an empty trailer for a full one. It was also observed that if this loss of time could be eliminated the field harvester could be kept busy. The blower was provided with a conveyor which was lifted to a vertical position while a new load of ensilage was driven into place and then lowered across the end of the trailer for unloading. After each load a considerable amount of cleaning up was required before the succeed-

An ensilage harvester at work in the field

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Indiana, June 1943. A contribution of the Power and Machinery Division. Journal Paper No. J-1133 of the Iowa Agricultural Experiment Station, Project 700, cooperative with the Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA.

J. B. DAVIDSON is professor of agricultural engineering, Iowa State College; C. K. SHEDD is agricultural engineer, farm mechanical equipment division (BPISAE, ARA), U. S. Department of Agriculture, and E. V. COLLINS is research professor of agricultural engineering, Iowa Agricultural Experiment Station.

(Left) Automatic winch driven with a gasoline engine for operating a drag fork in unloading ensilage • (Right) This shows the drag fork sliding ensilage from the side of trailer box to the conveyor hopper of the blower

ing load is driven into place. This cleaning up and manipulating the conveyor hopper required about one-fourth of the time as indicated.

A study of the data obtained from the preliminary tests lead to the following developments for improving operating efficiency and lowering the labor duty:

1 The trailer boxes were provided with hinged sides having hinges which provided a smooth surface over which the silage could be pushed in unloading. The sides of the trailer boxes extended over the conveyor hopper, preventing the ensilage from dropping between the trailer and hopper. In this manner much time was saved in cleaning up between loads.

2 The conveyor for the blower was lengthened to extend the full length of the 14-ft trailer box. In this way the distance the silage had to be moved in unloading was reduced nearly one-half. Incidentally, it was found that placing a raised platform under the outside wheels of the trailer, thus tipping the bed toward the conveyor, materially reduced the labor of unloading. The opposite side of the conveyor was made vertical to prevent bridging of the ensilage in the hopper. Cleats were added to the sides of the conveyor hopper to prevent the whole mass of ensilage in the hopper from moving to the blower inlet. A retarding mechanism made of binder packers was placed at the blower inlet to feed the ensilage to the blower at an even rate and prevent bridging.

The placing of the conveyor hopper parallel with the trailer bed required a change in the usual belt blower drive. This was done by using a power take-off drive with flexible shaft and suitable gearset to increase speed of the shaft to that of the blower.

3 An automatic winch powered with a small gasoline engine and operating a drag fork was tried out for pulling the ensilage off the load. The drag fork was made from one-half of a six-tined grapple hay fork, but in finishing the unloading a scraper board was placed over the teeth to scrape the load clean from trailer box.

It was planned, in an effort to reduce labor, to have the haulers do the unloading without additional help, but in the data reported a man was used to look after the tractor operating the blower, the adding of water, etc. In a later run this man was dispensed with and a four-man crew used in filling one silo.

TABLE 3. LABOR USED IN HARVESTING ENSILAGE WITH FIELD HARVESTER, AUTOMATIC WINCH FOR UNLOADING, MODIFIED EQUIPMENT AND TECHNIQUE

Equipment	Number of men
Cutting—ensilage harvester, two-three plow tractor	1
Hauling—three trailers with 7x14 beds and drop sides pulled with tractor having 10 to 12 mph road speed	3
Unloading—ensilage blower with long conveyor hopper and feeding mechanism operated by power take-off shaft; automatic winch and fork for pulling silage over side of trailer bed	1
Length of haul, 0.8 mile	

Labor*	Man-hours per acre	Man-hours per ton	Man-hours per cent
Harvesting	.8	.09	20
Hauling	2.4	.27	60
Unloading	.8	.09	20
Total	4.0	.45	100

*Does not include two men working in silo distributing and packing silage.

The winch was controlled by knots on the drag rope. By taking up a few feet of slack a knot on the drag rope running through a fork of a lever actuated a clutch on the winch. Another knot threw the clutch out at the end of the desired length of travel. The automatic winch materially changed the character of the labor of unloading as well as greatly reduced the amount.

Table 3 is an analysis of the labor used in harvesting ensilage with the changed techniques and equipment.

SUMMARY

The data reported in the tables indicate that the labor duty of 2.07 man-hours per ton for the corn binder and stationary cutter was reduced to 1.17 man-hours with the field harvester and conventional equipment, and to 0.45 man-hours with modified equipment and coordinated operations. The arduous labor was almost entirely eliminated.

A careful study of the data indicates that for a haul of 0.8 mile additional equipment for hauling would still further reduce the labor duty. A shorter haul would have the same effect. The data indicated that as modified the blower capacity could be increased about 17.5 per cent.

No effort has been made in this short paper to analyze the power and equipment expenditures.

A Farm Structures Clearinghouse

THE JOURNAL of the agricultural engineering profession, AGRICULTURAL ENGINEERING, contains the most valuable library of information on farm structures that exists today. This information is largely in the form of papers presented through the years before the Farm Structures Division at A. S. A. E. meetings. These papers contain the best thought of men of wide experience and training in the fields of agricultural engineering, animal husbandry, and farm management. The Farm Structures Division has furnished the stimulus for work in this field. Any presentation before the Division must have had careful preparation based on the underlying sciences to have a favorable hearing. The establishment of climatic zones for farm buildings, the formulation of a rational method of study of the economics of buildings, the development of scientific and practical methods of ventilation of animal shelters, the increase in efficiency of buildings together with a lowering of cost, the establishment of values for paint, the modernization of houses, and a great improvement in structural design can all be credited in large part to the activities of the Farm Structures Division. The farm building plan services which reflect these improvements and take them to the farmer have benefited the industry he represents in an amount that can be measured in millions of dollars.

Moreover, the A.S.A.E. Structures Division has served as a clearinghouse for advanced ideas that have put the development of farm structures far ahead of what it would have been without it, and while much remains to be done and progress seems very slow, there is every reason to believe the Division will be fully as effective in the solution of problems of the future as it has been in the past. — J. C. WOOLEY

Building Needs for Wartime Agriculture

By Roland A. Glaze
MEMBER A.S.A.E.

WARTIME means first of all to the farmers intensive demands for increased production; in Iowa alone 492,000 hogs are wanted over and above the number raised last year. Second, wartime means higher prices for his products; the present time farm products are bringing approximately 175 per cent of the 1910-14 price level. And, third, the period of the war will be one of larger profits. A hog raiser in Illinois sent me a memorandum showing a return of $225.89 for every $100.00 worth of feed fed in 1942. This man's hogs returned $1.96 per bushel of corn fed.

Increased production, higher prices, and larger profits are all desirable things from the farmer's standpoint, but he must increase his production with less help, and with less machinery. He is also faced with building restrictions. There are curtailments on nearly everything he needs. Feed for increased livestock has been curtailed, and he has to do some clever juggling of crops to make the available protein go around. He has to use substitutes for everything including labor and machinery.

For increased production the farmer needs feeders and feeding equipment. He needs grain storage buildings and housing facilities for hogs, poultry, and dairy stock. He needs buildings that will shorten his hours of labor because of their efficient arrangement. He needs buildings that will properly store his crops and feed, and above all he needs equipment items that will save him hours of laborious effort in feeding and caring for increased herds and flocks. He cannot as in the past go to his lumber yard, get the material, and build these things for himself. In the first place he is far too busy, and in the second place he is not naturally inclined to build things for his own use.

Let's go back to those 492,000 additional hogs that Iowa was asked to produce. Suppose all the farmers use the two litter system. This means that space would have to be provided for 246,000 hogs. Suppose each sow has seven pigs, we then have 30,750 litters to accommodate. Almost 40,000 individual hog houses would be required, and all at a time when building material supplies are limited. Similar figures could be developed for poultry, cattle, and crop storage requirements.

We see then the farmer's need for increased production and larger profit, restricted as he is with less help, less machinery, shortages of building materials, building restrictions, and curtailment of customary items of feed are mainly the following: Hog feeders, for rapid gains and labor saving; hog farrowing houses, to insure the utmost in protecting the little pigs and keeping them disease free; poultry brooder houses and brooder equipment; poultry roosts, nests, feeders, and waterers; stock feeders; feed bunks; livestock sheds.

The functional requirements of farm buildings and equipment in wartime should be much the same as they are in peacetime. One outstanding difference is noted, however; this is the element of cost. In normal times we are inclined to see how cheaply we can build a building or piece of equipment for the farmer's use, knowing perfectly well that he will gladly work more hours to save a few cents. In wartime, however, he does not have the extra hours, and he is ready, willing, and able to pay for the piece of equipment that will save him time, will put rapid gains on his livestock, or will properly store his crops.

Let's take feeders as an example of what can be done in the field of labor saving alone. I have a memorandum from a lumber dealer who advertises "Come to the lumber yard for hired men." Of course, he does not mean this literally, but he is selling man power to the farmer. Here is the record as he reports it. Up to the present time he has sold 179 cattle feeders. He estimated that each feeder saves seven days a month or 84 days per year for its owner. That totals up to an annual saving of 15,036 days of labor to the farmers of this country. He includes with his letter a long list of other feeding and yard built equipment all of which have saved a large number of hours of time on the farm, as well as the time saved for the farmer should he have been required to build them himself.

If it were possible to compute the hours of farm labor saved by countless buildings and farm yard equipment that have been fabricated in the lumber yards of the United States during the past two years, the total would amaze us all.

I said at the beginning of this paper that the first demand upon the farmer in wartime was for increased production. Properly designed buildings can increase production. Animal housing needs to be tight, warm, and dry in most cases. Can grain storage buildings increase production? I am sure you will agree that the answer is definitely yes. A properly designed grain bin will yield grain in better condition than when it was put into the bin.

A properly designed hog feeder will keep feed in front of the animals at all times and will not waste it by permitting the hogs to root it out on the ground. In our field investigations of hog feeders it was a common occurrence to have a farmer reply to our question on how his feeders were working that they were performing perfectly, that they required very little attention, and kept feed in front of the hogs at all times. Upon further investigation we would discover that the hogs were rooting the feed out onto the ground and trampling it under foot. This had either escaped the farmer's notice completely, or he did not think it important. As agricultural engineers charged with the responsibility of providing farmers and lumber dealers with correct designs, we must be sure that our grain bins protect and properly condition their contents. We must be sure that our feeders do not waste valuable feed. We must be sure that our hogs and poultry brooder houses are tight, and warm, and dry.

Maintenance of existing farm buildings is another need in wartime agriculture. We can all be proud of the fact that members of this organization have not overlooked that need but have spent a great deal of time, energy, and money promoting the proper care and maintenance of existing farm structures. I have no doubt that these efforts have resulted in the saving of great quantities of grain and in the increase of animal production because of tighter and more comfortable housing. The biggest handicap to a program of this kind is of course the shortage of labor to accomplish it.

We have heard a great many times that one carload of lumber used in the form of hog houses will equal ten carloads of fall hogs. One lumber dealer said with a great deal of pride that in his small crossroads town he had been able to provide enough brooder houses for

A group of feeding and other small equipment items found in a rural lumber yard

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943. A contribution of the Farm Structures Division.

ROLAND A. GLAZE is chief engineer, Weyerhaeuser Sales Co.

15,000 chicks, enough hog houses for 2,000 pigs. He feels that his contribution to the building needs for wartime agriculture has been just as great as any other individual in the country. At least he has done his share. Now he is working as hard as his limitation of materials and labor will permit to provide the housing and equipment to carry these extra animals and their feed requirements through the winter. When I was in his yard recently he had it full of yard-built equipment; I counted 35 nests, 35 poultry feeders, 21 hog feeders, 10 mineral feeders, 22 6-pen portable hog houses suitable for winter housing, 8 A-type hog houses, 16 hay racks, 16 1,000-bu granaries, and 7 16x20-ft portable poultry laying houses. Now he is spending most of his time on laying houses desperately trying to get the hens from those 15,000 chicks under cover for the winter. He had seven old men working on these items, all of which he had sold long before he got around to building them.

The lumber dealers in each community have shouldered their full share of the production problems. This same dealer paused long enough in his work to outline his farmers' needs for hog watering equipment. With no metal available could he make tanks out of what he had or had coming? We showed him some ideas we had picked up elsewhere and he didn't wait for us to finish the rough sketches (made on a block of wood) before he had a man at work on the idea.

The lumbermen of the country have accomplished miracles in making good use of the limited kinds of materials and items available to them. They have used everything they could get.

Everything we can do and have done to help is appreciated. The extension work being done along these lines in Minnesota, Ohio and other states has helped. More yet needs to be done. The time, brains, and energy put in by extension workers both in industry and in the colleges in helping the dealers supply needed equipment and housing items to their farmers result in increased production and man power saved that pays the country many times over and is a direct contribution to wartime agriculture.

Redistribution of Moisture in Soybean Bins

By Deane G. Carter and M. D. Farrar

FELLOW A.S.A.E.

MATURE soybeans stored in the fall at uniform moistures of 11 to 12 per cent may within a few weeks acquire dangerously high concentrations of from 16 to 20 per cent moisture in the upper part of the bin. This condition is important since moistures above 13 to 14 per cent are favorable to fungus growth, insect infestation, heating and loss of grade, and reduced germination.

In various studies this moisture accumulation has been observed in the upper layers of grain. Experiments with watertight coverings have shown that the condition is due to moisture movement within the grain rather than to wetting from rain or snow. In the fall and early winter, the grain near the outer wall is cooler than at the bottom or center of the bin (Fig. 1). It is assumed, therefore, that an air movement occurs down the sidewalls and up through the center, and that moisture is condensed when the rising air strikes the cool top layer of grain.

Vertical moisture determinations were made in 50 government-owned bins in 1942-43 to determine the effect on germination and other factors that measure the quality of soybeans. Samples were taken from the cells of a 5-ft probe at depths of 5½, 11, 16½, 27½, 38½, and 49½ in below the surface. Thus the probe cells yielded samples that were approximately ½, 1, and 1½ ft below the surface in the three top layers. The fifth cell was 27.5 in down, and the moisture in the fifth cell sample was normally as high or higher than the average for the whole bin.

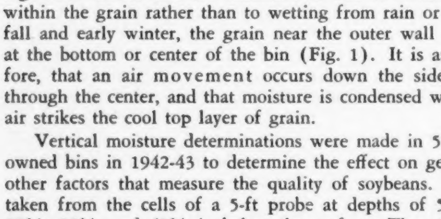


Fig. 1 Temperature variations in soybean bins (fall season)

Moisture determinations were made and averaged for 30 government-owned steel bins of 2,000 to 2,700 bu capacity about February 1, 1943, after 2½ to 3 months' storage. The moisture in the surface layer was 16.21 per cent, 15.21 per cent 12 in down, 14 per cent at 16.5 in below the surface. Moisture at 27.5 in was 12.17 per cent, which was close to the original bin averages. (Fig.2)

The shift in moisture in soybean bins is illustrated specifically and the effect on germination indicated by three bins under observation in McLean County, Illinois. The respective moisture percentages from the top down were 17.01, 17.44, 15.26, and 11.2. Germination tests from the same sampling indicated respective germination percentages of 49, 37, 81, and 86. Fig. 3 illustrates the relative changes in moisture and germination with respect to the bin averages.

TABLE 1. MOISTURE REDISTRIBUTION IN SOYBEAN BINS AND EFFECT ON GERMINATION

Bin No.	Moisture in Top Layer, Per Cent Nov.	Jan.	April	Germination, Per Cent Top	Body
2261	12.76	16.48	14.46	33.3	90.5
2263	11.95	18.89	15.38	0.5	92.0
2264	11.91	13.25	12.21	81.5	89.0

Table 1 indicates typical moisture changes in the top layer from the time of storage until April 1943. In each case the moisture increased after two months but declined toward spring. The germination percentage was lowest in the bin where moisture was highest in the top layer. Bin 2263, with a top moisture of almost 19 per cent, had only one live seed in the 200-grain sample.

Several steel bins included in the study were leveled off in January by the removal of about 200 bu soybeans from the top. Moisture in the grain which was removed ranged up to about 20 per cent. After two weeks or longer the top moisture was 1.58 per cent above the bin average, whereas the general average increase in thirty bins level full was about 4 per cent.

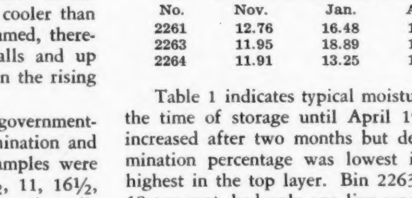


Fig. 2 Average vertical moistures January-February 1943 for thirty standard steel bins in upper layers (basin shaped)

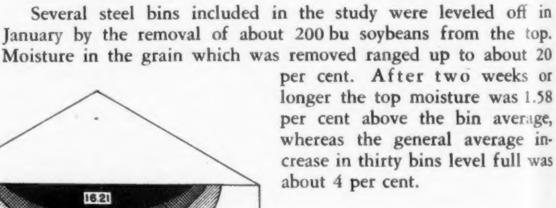


Fig. 3 Averages of moisture redistribution in soybean bins and effect on germination for three bins of 2700 bu each in McLean County, Illinois. Data for late winter of 1942-43

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Indiana, June, 1943. A contribution of the Farm Structures Division.

DEANE G. CARTER is professor of agricultural engineering, University of Illinois; M. D. FARRAR is entomologist, Illinois State Natural History Survey.

AUTHOR'S NOTE: Data on germination supplied by R. F. Fuelleman, Department of Agronomy, University of Illinois.

Land Drainage in England and Wales

By John T. Olsen

MEMBER A.S.A.E.

WORLD War II has created a difficult food situation for the United Kingdom. Under peacetime conditions about half her total food supply was imported, and that constituted about half of all her imports. War demands for shipping facilities have upset this balance. As stated by the Minister of Agriculture and Fisheries to the House of Commons, the food problem is a matter not only of "digging for victory" but also of "digging for dear life."

At the beginning of the war in 1939 about 18½ per cent of the area of England and Wales was cultivated land. War necessities have induced an all-out effort to increase food production on the part of government and farmers that has increased cultivated acreage from 6,900,000 in 1939 to 11,000,000 in 1942. To do this and to continue the program requires that large areas of fertile swamp and overflowed land be reclaimed by drainage.

The Drainage Program. The productivity of at least 4,362,000 acres in England and Wales, approximately one-seventh of the total acreage used for agriculture, is dependent upon artificial "arterial" drainage. This includes reclaimable land subject to tidal overflow, but not a large acreage for which outlet is available at the individual farms. These figures, the latest estimates made, are from the report of the Royal Commission on Land Drainage in 1927. Iowa has slightly less total area than England and Wales, but has probably 40 per cent more land dependent on artificial drainage. Of the total dependent upon drainage in England and Wales, 2,892,000 acres were organized in drainage districts; the figure in 1942 was 10 per cent greater. According to the Royal Commission, lands in "immediate need of drainage" were 1,755,000 acres of which one-sixth was included within drainage districts. Of the lands in immediate need of drainage 1,279,000 acres were suffering from overflow caused by inadequate or obstructed "arterial channels" so-called, while the other 476,000 acres could be improved by "small drainage schemes" for clearing main ditches and other small watercourses.

From the summer of 1940 to the end of 1942 the land drainage division of the Ministry of Agriculture and Fisheries bought and put on land drainage work about 400 small dragline excavators, and about 500 similar machines owned privately and by drainage districts and catchment boards were likewise engaged. Most of these are of ¼ to ½ cu yd bucket capacities. Under war pressure the government has attacked the drainage problem with an extensive program of main-drainage construction and rehabilitation and of farm ditching, tile drainage, and mole drainage. The Minister of Agriculture stated to the House of Commons on March 18, 1942: "We have already completed or have in hand the improvement of between 2,000,000 and 3,000,000 acres, and one of the most encouraging features is the extent to which farm ditching is being carried out. Up to the end of 1941 farm ditching schemes had been approved for 1,300,000 acres; 41 per cent of this work has been finished and 40 per cent is in progress . . . Approved mole drainage schemes cover 150,000 acres — 45 per cent finished and 36 per cent in progress. Tile drainage schemes cover 90,000 acres — 37 per cent finished and 46 per cent in progress. New schemes are pouring in now as fast or faster than ever. What is more, encouraging as that is, as the committees get more and more machinery and know more and more how to use it, the progress will be faster still. Every kind of machinery upon which we can lay hands is being used for drainage purposes in order to try and diminish the need for labor. . . . These machines are already performing very good operations, but as the drivers become more skilled the pace at which the schemes are carried out will enormously increase. But, even so, without great efforts from everybody we shall not be able to tackle more than a fraction of the work which still needs to be done. Unfortunately there are thousands of miles of ditches which are not doing their job, and in consequence tens of thousands of acres are waterlogged and cannot produce maximum crops. Ditches are the key to the whole drainage problem and I want farmers, landowners, farm workers, and my committees to make it their watchword to fight to the last ditch."

Organization for Drainage. The earliest drainage authority in England and Wales appears to be that for Romney Marsh originating in a Commission of Sewers issued about 1252 under Henry III. The practice of issuing such commissions became more or less permanent under the Bill of Sewers enacted in 1531. This bill gave these commissions generally vague powers which included authority to remedy annoyances, assess persons responsible, and seize property in arrears, but conferred no powers to execute new work. The famous Bedford Level Corporation, to control the great Fen area, was organized in 1661. The Land Drainage Act of 1861 provided for elective drainage boards. By 1927 there were some 361 drainage authorities.

The Land Drainage Act of 1930 is the present drainage law of England and Wales. It is based on the report of the Royal Commission on Land Drainage appointed in 1927 to make a thorough study of the whole matter of drainage law. This act not only consolidates and amends the prior legislation but also contains certain new provisions of great importance.

It established catchment areas, essentially over-all drainage authorities, one for each of most of the main drainage basins of England and Wales. The catchment board for each catchment area determines what streams shall be designated as "main river" drains to be improved and maintained by the board and supervises the drainage districts within its area. It has the authority and the duty to see that proper drainage districts are established within the catchment area to provide and maintain the tributary drainage systems and may revise, combine, or abolish existing districts. These powers have been put to good use. The members of the board are appointed by the Minister of Agriculture and the county councils and county borough councils and include representatives of the drainage districts.

The catchment board obtains its funds under the 1930 Act from two or three sources: (1) Each internal drainage board is required to contribute to the catchment board such amount as the latter deems "fair." (2) The counties and county boroughs wholly or partially

A light-weight and specially mobile excavator of the swing-boom type for digging and cleaning out farm drainage ditches in England. The bucket is tapered to fit the ditch section and the side arm permits working from beside the ditch

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JOHN T. OLSEN is senior drainage engineer, drainage division (SCS), U. S. Department of Agriculture.

within the catchment area contribute the remainder of the money needed by the catchment board, except as aid may be obtained from the third source. (3) The Minister of Agriculture may make grants to the catchment boards out of moneys provided by Parliament and in amounts sanctioned by the Treasury for improving existing drainage works or constructing new works. Government grants are not available for administrative or maintenance expenses.

Drainage districts construct and maintain drainage systems tributary to the "main river" drains of the catchment areas. Districts established under earlier laws are, by Act of 1930, brought under jurisdiction of the catchment areas in which they are situated. Each district is financed under this act by taxes levied against the real property in the district, agricultural land paying on the basis of its full "annual value" and other property, including farm buildings, at the same rate on one-third its "annual value". ("Annual value" is an assessed valuation of annual rental or production value made for income-tax purposes.) Provision is made, however, allowing the district board to divide its area into subdistricts and apply different rates, including no rate, in the different subdistricts.

The contribution of each county or county borough council to the catchment board may be collected as part of the general expense fund, or by a special tax levied on a part of the county or borough, or by special taxes at different rates on such parts of the county or borough as the council may see fit. Because of the "derating" provisions of the Local Government Act of 1929 agricultural land does not contribute to county and county borough expenses. In a catchment area without any internal drainage districts, therefore, agricultural land does not pay anything toward the main river drainage work.

THE LAND DRAINAGE ACT OF 1930 CREATED ONE AUTHORITY FOR EACH DRAINAGE BASIN

The Land Drainage Act of 1930, it will be noted, did three important things: (1) It created one authority for each main drainage basin which has management of all the drainage in the basin from field to sea. (2) It departed from the principle of assessing all the cost of drainage against land in proportion to direct benefits. (3) It established the principle of government grants-in-aid for drainage of agricultural land.

Since passage of the 1930 Act, and especially in the past few years, supplemental acts have authorized the Minister of Agriculture to make grants-in-aid to drainage districts and to individual farmers. The grants to catchment boards have been made in amounts ranging from 30 to 75 per cent of the approved cost, averaging 55 per cent, and to April 30, 1942, totaled 8,925,000 pounds. Grants to drainage district boards and to farmers are made on the basis of 50 per cent of the approved cost and to the same date amounted to 1,165,000 pounds for drainage districts and 1,229,000 pounds to farmers. The grants to farmers were for farm ditches, tile drains, and mole drains on 1,862,000 acres and were equivalent to about $2.65 per acre.

War Agricultural Executive Committees. Emergency powers (defense) in 1939 placed upon the Minister of Agriculture and Fisheries the heavy responsibility of directing a campaign to increase food production in the United Kingdom. To him were given powers (1) to enforce such directions with respect to cultivation or use of land as he thinks necessary or expedient for increasing or maintaining production of articles essential to the life of the community; (2) to terminate the tenancy of any agricultural holding if the tenant has not cultivated it according to the rules of good husbandry; and (3) to put into effect measures to prevent or minimize injury to crops or trees or wastage of pasture by birds, animals, or vermin.

By the Cultivation of Lands Order (1939) the Minister appointed a war agricultural executive committee for each county in England and Wales to exercise on his behalf certain of the powers conferred on him. The counties were divided into convenient districts, in most cases corresponding to the established rural districts, and for each a subcommittee was selected to serve as the eyes and ears of the county committee. Under provisions of defense regulations the war agricultural executive committee as of February 28, 1942, in England and Wales were directly managing 5,333 tracts comprising some 366,000 acres of agricultural land.

The war agricultural executive committees have the leading part in carrying out the farm drainage program. Requests for government grants-in-aid from owners or occupiers of agricultural land are made and received through these committees. They advise farmers whose lands need drainage as to the best methods to employ, whether open ditches, tile drains, or mole drains for each tract. They must satisfy themselves as to the desirability and reasonable cost of the proposed work before approving an application for government grant. They procure the machinery for constructing the drains from the Ministry of Agriculture, purchase the materials required, employ the labor, and obtain the installation of the drains. The farmer's share of the cost may be paid either on completion of the work or in installments over a reasonable period of time. The committees see that the ditches and streams not directly under catchment boards or drainage district boards are maintained by the owners or occupiers of the land. They may ask a drainage district to prepare and carry out a plan for draining land within the district, and may ask a catchment board to make and carry out a plan for draining lands outside of or within a drainage district and within the catchment area. As of April 30, 1942, these committees had approved 63,951 farm drainage schemes for improving 1,862,419 acres at an estimated cost of 2,458,784 pounds. The engineering phases of the committees' drainage activities are subject to review by the land drainage division of the Ministry of Agriculture and Fisheries.

The Land Drainage Division, Ministry of Agriculture and Fisheries. The land drainage division was established in the Ministry of Agriculture and Fisheries prior to enactment of the Land Drainage Act of 1930, to aid the Minister in administering earlier statutes. Under the Act of 1930 this division investigates and approves the establishment of catchment areas and drainage districts and reviews and approves the engineering plans of the catchment and district boards. Under the emergency agriculture acts the division must also review and approve the individual drainage schemes for which government grants-in-aid are made, and it is responsible for the allocation of materials and of government drainage machinery to grant-aided projects.

The technical staff of 18 engineers functions under the administrative staff as advisers on matters relating to technical aspects of land drainage. The needs of the armed forces for technical personnel has made it impossible for the drainage division to expand in pace with the requirements for cropland expansion, so the division engineers have had to give full time to supervisory duties and neglect in some degree the planning of drainage works.

THE TECHNICAL FUNCTIONS OF THE LAND DRAINAGE DIVISION COVERS STUDIES OF RAINFALL, RUNOFF, ETC.

The purely technical functions of the land drainage division cover studies of rainfall, runoff, tide movements, flood control, outlet systems, and farm drainage. It may be interesting to note here some of the basic conditions with which the division has to deal.

Precipitation in England and Wales varies greatly in the relatively small area. The range in average annual rainfall is from less than 20 in in the nearly level lowlands of eastern England to more than 150 in in the mountains of Wales. The major agricultural areas lie in eastern and southern England where precipitation averages 22 to 30 in per year.

English drainage engineers have more or less standardized runoff requirements of drainage systems in the principal agricultural areas. Drainage outlet ditches for the most part are designed with coefficients of 1/4 in in 24 hr for flat agricultural areas and 3/8 in in 24 hr for rolling and hilly lands. Pumping plants are designed to deliver 1/4 in of runoff in 24 hr.

The practicability of developing low areas often depends upon the range of tides as well as the elevation of the land. Tides along the eastern coast commonly range from 12 to 30 ft, and along the western coast may be as great as 40 ft or more. Proper study of reclamation plans frequently requires the development of tide curves to determine how much of the drainage runoff can be removed by gravity and how much must be pumped. Many areas in England and Wales that would be suitable for agriculture if drained will require extensive protection and drainage works that would not be economical under normal conditions.

Levees, sluiceways, pumping plants, tide gates, and training walls are used in controlling floods and preventing overflows. Exacting engineering studies and careful planning are always essential to successful development of lowlands. *(Continued on page 303)*

Thomas Jefferson and Agricultural Engineering

By M. L. Wilson

IN THE heart of our nation's capitol the park system has been laid out in the form of a great cross. At the intersection stands the Washington Monument. At the west end stands the Lincoln Memorial. At the east end is the Capitol. To the north is the White House. And to the south now stands the Jefferson Memorial.

Thomas Jefferson's Memorial was dedicated this year on April 13. It marked the second time within little more than a decade that Americans have had an opportunity to observe the bicentennial of one of their great leaders. In 1932 we celebrated that of George Washington, our first President.

There is this difference between Washington's bicentennial and that of Jefferson. In 1932 we were at peace. Our people had the opportunity to devote considerable time to celebrations in honor of Washington. Today, we are at war. Events press for our attention. We cannot pause, but there is more reason than ever to commemorate Jefferson and do things in his honor and in memory of the great contributions he made toward a better world and the foundation of our system of free government and democratic institutions.

In Congress today (June 23) a resolution has been introduced in the Senate by Harry F. Byrd and in the House by Howard W. Smith, both of Virginia, providing for a National Agricultural Jefferson Bicentenary Committee. This resolution calls on groups in the field of agriculture, including the agricultural learned societies, to give appropriate recognition to Jefferson, farmer and pioneer leader in the field of scientific agriculture.

Jefferson was an agricultural engineer. Therefore, it is most appropriate that the American Society of Agricultural Engineers should be among the first of our agricultural groups to honor Jefferson's name. We assume that if this Society with its emphasis on high professional standards had existed during Jefferson's lifetime he would undoubtedly have been a member.

Recognition of the breadth and versatility of Thomas Jefferson has increasingly come to the fore. He has long been revered and popularly known for such great contributions as the writing of the Declaration of Independence; representation of our cause and our country in France during the early years of our national existence; the part he played in bringing about the Louisiana Purchase while he was President of the United States. Today, in many fields, including science, philosophy, education, and farming, Jefferson is rightfully regarded as a pioneer leader.

Like our first great national figure, George Washington, Jefferson was a practical man who carried out a practical task, the management of a great farm project. But more than this, he laid the foundation for advancement in many of the scientific and technological as well as the humanistic aspects of the development of our agricultural life. His outstanding leadership in the field of agricultural engineering may be discovered in contemporary appraisals and publications and in his own accounts.

The agricultural experiment stations, the land-grant colleges, the meetings of our scientific agricultural societies, and projects such as the experiments with tillage machinery at the USDA Soil Tillage Laboratory and Alabama Polytechnic Institute at Auburn, Alabama, are, in a true sense, the living memorial of the scientific leader among our farmer presidents. From the world viewpoint, Jefferson was among the foremost statesmen of his day. From this same viewpoint he was the Leonardo da Vinci of his time. Nothing in the field of eighteenth century science was beyond his compass. Yet nothing about his estates and agriculture, for him, was too small for recording. The details of a barnyard gate, the construction of a market cart, came in for careful study and consideration. His maps and sketches show the buildings, elevations, and many other details of his several farms. As an agricultural engineer he grasped the forces of nature and spent many years in directing them in the interest not only of a better Monticello, but a fuller life for his fellow men.

Personality and Background. Jefferson was always a farmer. Even through his many years of public service he kept in close touch with the managers of his farm at Monticello. He died on the same farm on which he was born.

Thomas Jefferson was born in 1743 within sight of Monticello at Shadwell, located on the red Davidson soil of Monticello. His father died when Jefferson was a boy of 14. At William and Mary College he came under the influence of the broad-minded scientist, William Small. Later he studied law under the tutelage of the learned and great lawyer George Wythe.

Following admittance to the bar at the age of 24, Jefferson returned to Shadwell to build Monticello and to give attention to the 1,900 acres left by his father. His holdings were more than doubled before his marriage at the age of 29. He inherited 5,000 acres more from his father-in-law.

Jefferson entered public life at an early age. He was elected to the Virginia legislature at the age of 26; to the Continental Congress at 32. He wrote the Declaration of Independence at 33, and had become governor of Virginia at 36. He subsequently became minister to France and Secretary of State under George Washington. After 3 years away from public life, he was elected Vice-President, and then President. After serving two terms as President he retired to his farm at Monticello, taking an active part in the building of the University of Virginia. He died at the age of 83.

A Lover of Rural Life. "No culture," Jefferson wrote, "is so delightful as is the culture of the earth. . . . The greatest service which can be rendered any country," he believed, "is to add a useful plant to its culture." Agriculture he defined as a science of the very first order counting among its handmaids chemistry, natural philosophy, mechanics, and like fields of human endeavor. He stressed the importance of experiments in agricultural progress. "If in a multitude of these," he said, "we make one useful acquisition, it repays our trouble."

It is through his many writings that we can learn of Jefferson's deep passion for farming and farm life. He averaged 15 letters a day.

Some 50,000 Jeffersonian documents are in existence. Two of great interest to every student of the agricultural Jefferson are his Garden Book and Farm Book. The Garden Book covers a period of 58 years; the Farm Book about 48. The Farm Book is systematically organized into 17 divisions and 50

Monticello today. Jefferson's mountain-top home was the center of one of America's great early experimental farms. *(Photo by courtesy U. S. Soil Conservation Service)*

An address before the 36th annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June 1943.

M. L. WILSON is director of extension work, U. S. Department of Agriculture.

subdivisions. It mentions such equipment, buildings, and conveniences as plows, harrows, rollers, hoes, wagons, carts, threshing machines, treading floors, granaries, timber, fuel, fences, and roads. He was familiar with not only their practical use and purpose but the mechanical principles involved in their design and construction.

The Monticello Farms. In 1794 Jefferson, following his tenure as Secretary of State under President George Washington, was back at farming "with an ardor," he wrote Washington, "that I scarcely knew in my youth." We know something of the physical layout of his land and buildings because of his ability as a surveyor and map maker. His map of a proposed division of the Northwest Territory into states is well known. The fact that he laid out with his theodolite the site of the University of Virginia is also familiar. His maps and sketches showing buildings, elevations, and other details about Monticello have been given less attention. There were about twelve hundred cultivated acres at the base of the mountain. This area was divided into four farms and each farm was divided into fields to facilitate rotations.

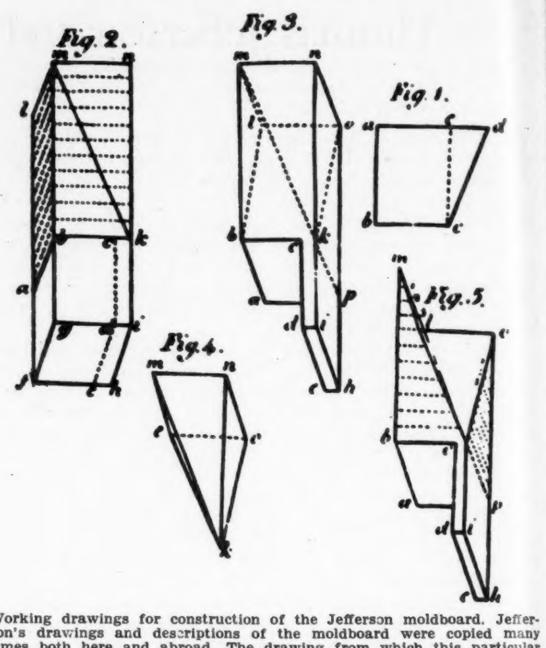
Experimental Records. Monticello was Jefferson's home and the center of his economic interests. But actually the farmlands there may be regarded as a great experimental farm. A laboratory was to be found in its shops and buildings. An agricultural library of many volumes was in Jefferson's study. This was perhaps the most diversified library of its type owned by a private individual in the United States. Jefferson, while away, gave his manager access to its books. The "experiment station records" are to be found in Jefferson's memoranda, correspondence, the Farm and Garden Books, and other writings. Qualitative expression in the entries illustrates his scientific bent. The exact ratio of grain to straw yields is computed. The determination of the size of fruits is given consideration. The use of hypothesis is frequent. From his careful entries, a picture of his work with crops, livestock, farm machinery, and home industry can be drawn. This served as a background for his interest in soil conservation and the establishment of agriculture as a subject of instruction in the curriculum of the institution of higher learning.

JEFFERSON WAS INTERESTED IN THE INTRODUCTION OF NEW SPECIES OF PLANTS AND CROPS TO THE UNITED STATES

Crops and Plants. Jefferson had two main interests with regard to plants and crops. He was interested in the introduction of new species to the United States and in methods of planting that would help to protect the soil. Before the Revolution he had been one of a company who brought an Italian, Philip Mazzei, to Albemarle to promote viniculture. His early records indicate experiments with fruits such as nectarines, pomegranates, and figs. In promoting international exchange of agricultural products, he was one of the many figures from Aristotle to David Fairchild who have served mankind by distributing the fruits of the earth. For many years he received seed shipments regularly from the superintendent of the Garden of Plants at Paris.

Mandan corn and other seeds brought back from the West by the explorers, Lewis and Clark, were among his plantings. Among exotics which he imported from abroad, he later believed his work on behalf of the promotion of African dry rice culture to be particularly significant. At Monticello he was especially interested in soil-restoring crops such as legumes. Constant planting of tobacco and other staples had helped to exhaust the soil. Jefferson worked out a series of rotations. A 7-year cycle ran as follows: First year, wheat; second, corn; third, peas or potatoes; fourth, vetches; fifth, wheat; and in the sixth and seventh years, clover.

Livestock. Jefferson's interest in livestock improvement dates back to his early years, when he kept careful records of horse breeding. For the most part, however, during his absences little attention was paid to stock improvement. The hogs, as was the custom on Virginia plantations, ran wild in the woods until the fall roundup. Jefferson's identifying mark in Albemarle was a "crop and slit in the right ear and an under-worked slit in the left ear." After the importation of some black and white Calcutta hogs greater attention was paid to breeding which was placed on a profitable basis. Farmers bringing three sows took away two and left one to augment Jefferson's stock. While President, Jefferson must have maintained some sort of an enclosure or storage place near the White House or the stables, for he not infrequently wrote that he had on hand for forwarding to Monticello such things as ducks,



Working drawings for construction of the Jefferson moldboard. Jefferson's drawings and descriptions of the moldboard were copied many times both here and abroad. The drawing from which this particular facsimile was made first appeared in published form in the Transactions of the American Philosophical Society, volume IV (1799)

chickens, and guinea pigs. He was very careful about the type of buildings on his plantations, and when, in 1804, he sent a pair of Algerian fowls with fine aigrettes he wrote his daughter that on his return in the fall he would design and superintend the construction of a special hen house which was to be for that variety of birds.

During his term as President, Jefferson imported two varieties of sheep, merino and broadtailed, which possibly came from Barbary. The merinos were particularly successful, and through a procedure similar to that in connection with hog breeding—sheep owners bringing two ewes and taking away one lamb—the Monticello flocks were quickly built up to several hundred sheep. Jefferson was very anxious to spread stock improvement throughout Virginia. In 1810 he proposed to another sheep enthusiast, President Madison, that they distribute their full-blooded males, one to a county throughout the state. This process, it was estimated, would take about 7 years and would involve the promotion of breeding societies to maintain the rams.

Farm Mechanics. Farm machinery at Monticello, and throughout the United States for that matter, at the close of the eighteenth century was primitive. But alert agriculturists, such as the members of the Philadelphia, New York, and South Carolina agricultural societies, followed closely and contributed to developments in the agricultural revolution. Jefferson kept in close touch with societies of this kind both here and abroad. In his later years he helped to found the Albemarle County Agricultural Society, and became an active member.

Jefferson's mind was directed to mechanical improvement not only by a natural bent for the subject and a need for its exercise at Monticello, but also because of his duties as Secretary of State. In this office he was chairman of the Patent Board, including the Secretary of War and the Attorney General, which passed upon and issued patents. Among patents of an agricultural nature granted during his chairmanship was the first one granted in the United States—that to Samuel Hopkins for a method of making pot and pearl ashes, in July 1790. Other patents covered the manufacture of flour, the preservation of plants from frost, and a threshing machine. Jefferson believed that the inventor should be protected in his rights, but did not believe patent holders should take unfair advantage of others. As an inventor he took out no patents, but because of his mechanical knowledge he was frequently consulted by other inventors and those seeking patent rights. His own interest in farm equipment is indicated by the headings in his farm

memorandum book which include the plow, the harrow, the roller, wheelbarrows, the threshing machine, and other devices.

The Plow. Of the various implements with which Jefferson experimented, the plow stands foremost in significance. He first mentions the plow in 1786, when on a trip from Paris to the Rhine he saw the difficulties of the peasants with their heavy, straight moldboard plows. That night he sketched in his journal a method of constructing a plow with a winding moldboard, so designed on a principle of straight-line construction as to raise and turn the sod with economy of effort on the part of both the plowman and the draft animals. Simplicity of construction is a keynote of his contribution. Improved moldboards had been made by various persons, as Jefferson undoubtedly was well aware. But in general, the method involved in producing a winding moldboard was too complicated for the great mass of farmers. Consequently when a moldboard split the plowman usually would follow the simplest course and adz a straight moldboard roughly out of a convenient tree. What Jefferson supplied was a simple formula whereby the husbandman could, with common implements, construct a winding moldboard. A plow fitted with this moldboard would, he believed, operate to the greatest advantage or offer the "least resistance." The general shape of this moldboard was not unlike that seen today in the stubble plow.

There is a long story in connection with Jefferson's moldboard, his many letters on its use, and the various editions through which the moldboard description passed, both here and abroad. It represented the last great fundamental development in the construction of wooden plows, the products of the family farm. It also had a fundamental effect on plow design throughout the western world. Publication of its description in the United States, France, and Great Britain centered attention on the plow and the necessity for further efforts toward improvement. A Jefferson moldboard, constructed at the Paris Museum of Natural History, was placed among the museum's agricultural exhibits as a study in the course of agricultural education. In the United States the moldboard description was first read at a meeting of the American Philosophical Society in 1798. Several years later the moldboard was placed on exhibition at a meeting of the Philadelphia Society for the Promotion of Agriculture.

Jefferson in 1798 had planned to cast his moldboard in iron. The credit for this practice in the United States goes, however, to others. Among these was Jethro Wood, who produced a moldboard representing, significantly, in his words "a sort of plano-curvilinear figure." Wood's plow, however, worked badly in the heavy western soils which clung to its pitted surface. Sometimes the large wooden plow was preferred to the metal until after 1837, when the steel plows developed by John Deere came into production. A model of one of these plows, dated 1838 and made from a broken circular steel saw blade, is now on exhibition at the United States National Museum. In the forties a factory was established in Moline, Ill., and a few years later the prairie farmers were buying thousands yearly. Then came the Oliver chilled-steel plow, another fundamental development leading up to our present-day plows.

Scientific Thoroughness—The Dynamometer. Those engaged in agricultural engineering will not fail to recognize Jefferson's scientific thoroughness in his writings on the moldboard of least resistance. He repeatedly expresses a desire for practical, measurable tests of the moldboard. In a letter written by him at Monticello on July 3, 1796, and addressed to Mr. Jonathan Williams of the American Philosophical Society he states:

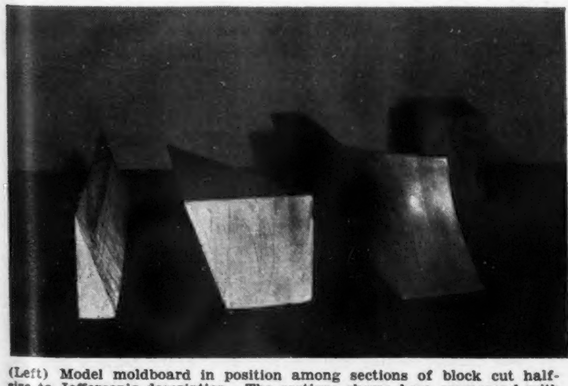
" * * * I only wish for one of those instruments used in England for measuring the force exerted in the drafts of different ploughs, etc., that I might compare the resistance of my moldboard with that of others."

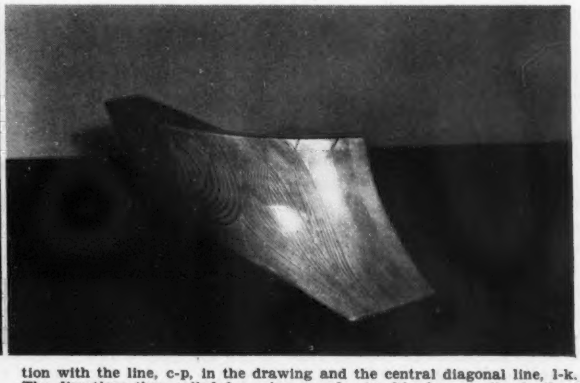
On July 15, 1808, in addressing Monsieur Sylvestre of the Agricultural Society of the Seine (France), Jefferson writes:

"I shall with great pleasure attend to the construction and transmission to the Society of a plough with my moldboard. This is the only part of that useful instrument to which I have paid any particular attention. But knowing how much the perfection of the plough must depend, 1st, on the line of traction; 2nd, on the direction of the share; 3rd, on the angle of the wing; 4th, on the form of the moldboard; and persuaded that I shall find the three first advantages eminently exemplified in that which the Society sends me, *I am anxious to see combined with these a moldboard of my form, in the hope it will still advance the perfection of that machine.* But for this I must ask time till I am relieved from the cares which have more now a right to all my time, that is to say, till next spring" (that is, until after the expiration of a second term as President of the United States).

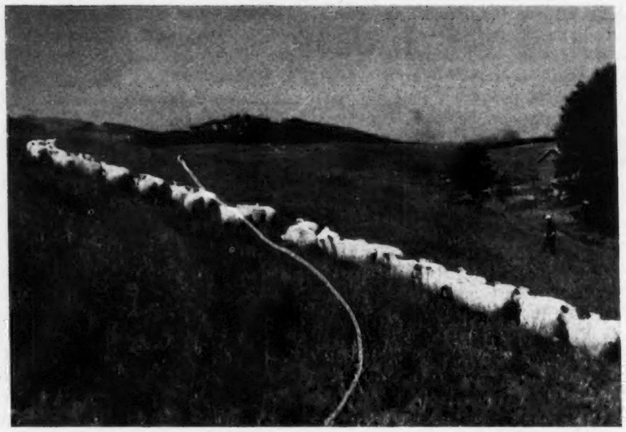
In 1810 when the plow for the French Society was finished and ready for testing, he wrote his fellow-inventor, Robert Fulton, on April 16, as follows:

"The Agricultural Society of the Seine sent me one of Guillaume's famous plows, famous for taking but half the moving power of their best ploughs before used. They at the same time requested me to send them one of our best with my moldboard to it. I promised I would, as soon as I returned home and could see to its construction myself. In the meantime I wrote to a friend at Paris to send me a dynamometer, which he did. Unfortunately this, with some other valued articles of mine, was lost on its passage from Washington to Monticello. I have made the plough and am greatly deceived if it is not found to give less resistance than theirs. In fact I think it the finest plough which has ever been constructed in America. *But it is the actual experiment alone which can decide this.* I was, with the greatest reluctance, about to send off the plough untried when I received your kind offer. I will pray you to send the instrument to Mr. Jefferson of Richmond by some careful passenger in the stage, who will see that it does not mis-





(Left) Model moldboard in position among sections of block cut half-size to Jefferson's description. The sections shown here correspond with the details shown in the accompanying drawings. There are three pieces to saw out and remove. First, the piece to the extreme left is removed, providing the overhang indicated in Fig. 1 of the drawing. The rectangular piece on the extreme right is then removed, exposing the tailpiece as shown in Fig. 3. The wedge-shaped piece shown to the left of the moldboard is then removed. This piece corresponds to Fig. 4 in the drawing. The original directions for finishing the moldboard called for hand-sawing, using the parallel dotted lines indicated in Fig. 5 as guides. The depth of these saw cuts was limited to points of intersection with the line, c-p, in the drawing and the central diagonal line, l-k. The directions then called for using an adze to chip down to the depth of the saw cuts which determine the curvature of the moldboard surface. The model shown in the photographs was made in the USDA Bureau of Plant Industry, Soils and Agricultural Engineering laboratory at Beltsville, Maryland, using laminated wood instead of a log and using a chisel and file for smoothing instead of an adze • (Right) The Jefferson model moldboard. Jefferson wrote John Taylor on December 29, 1794, concerning this moldboard, "It may be made by the most bungling carpenter and cannot vary a hair's breadth in its form but by gross negligence"



At Shadwell, Jefferson's birthplace, conservation is practiced today and the grass grows high. Monticello is in the distant background. *(Photo by courtesy U. S. Soil Conservation Service)*

carry by the way, or by some vessel bound from New York direct to Richmond, which is the safest though slowest conveyance."

The Threshing Machine. Although Jefferson did not invent the threshing machine, he contributed to the introduction of improved models in the United States. Threshing machines had been invented and improved in Scotland during the eighteenth century, and Jefferson, through Thomas Pinckney, ordered one of these machines for use at Monticello. So convinced was he of its merits that he arranged for the showing of the model in Richmond. This machine was geared for horse power and fitted with a revolving cylinder and concave surface arrangement into which the grain was fed, heads first. Jefferson's first machine was put into operation in 1796. He improved it by mounting it on wagon wheels so that it could be moved about the field, and a few years later had two machines on his plantation. He was also instrumental in obtaining for an American inventor, T. Martin, a patent on an improvement for the Scotch thresher.

Flour Milling. Jefferson's policies while President had affected many phases of his plantation's economy. The embargo, through tying up seagoing trade, forced communities to become more self-reliant in the matter of manufacture. There was a small flour mill near Monticello, but at the urging of his neighbors Jefferson undertook erection of a larger establishment. He made careful drawings of construction details and brought a millwright from the North to superintend construction. The mill built in 1807 was a stone structure four stories high with four runs of stone. This operation cost thousands of dollars. The dam was three-fourths of a mile above the building. Much of the millrace, in the form of a riverside canal 12 feet wide to permit the passage of barges to Charlottesville, had to be blasted out of solid rock. The flour was sold in Richmond, but the cost of keeping up this enterprise appears to have been large.

The Nail Factory. A nail factory, started at about the same time as the flour mill, proved for a time a profitable investment. Nine men superintended by a smith, who was paid in a share of nails, worked at two forges. At one time $2 a day over the cost of coal and iron rods was being cleared. Neighboring plantation owners and farmers were customers. James Monroe in 1810 complained of a mistake in an order and stated that eightpenny nails were required for hogsheads. Edmund Bacon, who was Jefferson's manager, states that large sales were made to people putting up buildings and that many stores in the region were supplied. The war of 1812, however, cut off the supply of iron rods, and the business was abandoned.

Textile Manufacture. Clothing, from the raw materials to the finished product, was turned out at Monticello. Cotton, wool, and hemp were all produced at various times. Silk experiments, however, did not turn out well. Cotton cleaning was done by hand, though when Jefferson as Secretary of State had considered Eli Whitney's patent for the cotton gin, he inquired into the possibilities of purchasing a machine for Monticello. He apparently found it more practical, however, to order ginned cotton from the states to the south. The wool from the merinos was made into cloth, and a sketch sent Charles Wilson Peale shows the type of fulling apparatus used at Monticello. The best cloth for work clothes Jefferson found to be a mixture of cotton and hemp. To prepare the hemp he devised a hemp brake — a wooden mallet worked by a cog arrangement fitted to the horizontal wheel of the horsepower of his threshing machine. As with his other improvements, he sought no exclusive rights to this, and to protect others in their enjoyment of its use he stated in 1815, "as soon as I can speak of its effect with certainty, I shall probably describe it anonymously in the public papers in order to forestall the prevention of its use by some interloping patentee."

There were three spinning machines at Monticello, one with 36 spindles, one with 18, and one with 6. Cloth was supplied for all the plantation staff, and the surplus was marketed. Bacon, his manager, stated that he had sold "wagon loads" of it to the merchants. In 1812 Jefferson received a piece of homespun from John Adams, who had maintained a 12-year silence since Jefferson beat him at the polls in 1800. The two friends now were reconciled and carried on a correspondence that lasted to the end of their lives. Jefferson had never feared the development of industry, as such, in the United States. He had, however, feared the appearance of poverty and vice attendant upon the growth of industrial cities in the past. In his reply to Adam's first letter, he expressed his pleasure in the fact that home manufactures were being stimulated and expressed the belief that though the South, by home industry, would produce sufficient coarse clothing, it would look to New England in purchasing the finer textiles. He believed in an "equilibrium of agriculture, manufactures, and commerce." In 1816 he stated, "Manufactures are now as necessary to our independence as to our comfort."

Soil Exhaustion and Erosion. Those who have examined Jefferson's accounts know that in the latter part of his life he was deep in debt. Despite his progressive attitude in the matter of mechanical, crop, and livestock improvements and the development of home industry, the Monticello farms apparently did not pay. Many reasons may be given for this, and from the agricultural standpoint the following are important. There were the long periods of public service during which Jefferson had to leave his lands to the care of managers. There were the marketing difficulties which were experienced by other plantation owners. Then there was the basic factor that the red soils of his estate quickly gullied and washed away. There is a big clock, designed by Jefferson, under the portico at Monticello. In some ways, I think, a clock is symbolic of the plantation itself. Jefferson after his return to farming was constantly engaged in improving the works of the plantation, but the mainspring, the soil, had been weakened by 60 years of planting, chiefly in the clean-tilled crops, corn and tobacco. "Time, patience, and perseverance," Jefferson knew, were necessary to restore the soil. Rotations were one method he employed; another was contour plowing.

Soil Conservation. Where Jefferson learned about contour plowing is not known. Its origins are as old as our oldest records. He may have read its description in his library volume of Columella or have seen it practiced on the slopes of Europe. What is important is that his was the first great voice in the United States to urge its practice. A hillside plow designed by his son-in-law, Thomas Mann Randolph, was used at Monticello. An A beam diagrammed by Jefferson was used to run the levels. Contour plowing together with the use of plaster clover would, he hoped, again restore the fertility of the soil, which once he said was "exceeded by no upland in the state." In a letter written to Charles W. Peale, April 17, 1813, Jefferson wrote:

"Our country is hilly and we have been in the habit of ploughing in straight rows whether up or down hill, in oblique lines, or however they lead; and our soil was all rapidly running into the rivers. We now plough horizontally, following the curvatures of the hills and hollows, on the dead level, however crooked the lines may be. Every furrow thus acts as a reservoir to receive and retain the waters, all of which go to the benefit of the growing plant, instead of running off into the streams. In a farm horizontally and

deeply ploughed, scarcely an ounce of soil is now carried off from it. In point of beauty nothing can exceed that of the waving lines and rows winding along the face of the hills and valleys. The horses draw much easier on the dead level, and it is in fact a conversion of hilly grounds into a plain. The improvement of our soil from this cause the last half dozen years strikes every one with wonder. For this improvement we are indebted to my son-in-law, Mr. Randolph, the best farmer, I believe, in the United States, and who has taught us to make more than two blades of corn to grow where only one grew before. If your farm is hilly, let me beseech you to make a trial of this method. To direct the plough horizontally we take a rafter level of this form. (A sketch of the level is included here in the manuscript.) A boy of thirteen or fourteen is able to work it round the hill, a still smaller one with a little hough marking the points traced by the feet of the level. The plough follows running through these marks. The leveller having completed one level line through the field moves with his level 30 or 40 yards up or down the hill, and runs another which is marked in like manner and traced by the plough, and having thus run what may be called guide furrows every 30 or 40 yards through the fields, the ploughman runs the furrows of the intervals parallel to these. In proportion, however, as the declevity of the hill varies in different parts of the line, the guide furrows will approach or recede from each other in different parts, and the parallel furrows will at length touch in one part when far asunder in others, leaving unploughed gores between them. These gores we plough separately. They occasion short rows and turnings which are a little inconvenient, but not materially so.

"I pray you to try this recipe for hilly grounds. You will say with me, 'Probatum est', and I shall have the happiness of being of some use to you, and through your example to your neighbors, and of adding something solid to the assurances of my great esteem and respect."

JEFFERSON PROMOTED CONTOUR PLOWING AND OTHER CONSERVATION PRACTICES BY PERSONAL EXAMPLE

Jefferson promoted contour plowing and other conservation practices by personal example, correspondence, and published communications. In a letter to the "American Farmer", published in 1820, he states that contour plowing was being practiced near Lynchburg which was many miles distant from Monticello. In this promotion of soil conservation Jefferson was 100 years ahead of his time. When so much cheap land existed, the difficulties of spreading a conservation message were large.

Science, Learning, and Human Values. In this short review of Jefferson's interest in the technical aspects of agriculture, little emphasis has been laid on his appreciation of the human values as a part of the agricultural way of life. Jefferson's fundamental quest in his many fields of activity was for their bearing on the worth and dignity of the human personality. Though science and technology are a part of the farming picture, he keenly realized that human values are the essential elements in its composition. Jefferson was the first great advocate of agricultural education in "every" institution of higher learning in our country.

One of the proposals made by the Albemarle Society, in which Jefferson took a leading part after his return to Monticello, was that a chair of agriculture be established at the University of Virginia. In a letter written on January 24, 1819, to Mr. Simeon Dewitte, the surveyor general of New York, Jefferson commented:

"I have always thought that a professorship of agriculture should make a part of the establishment in all our Universities, thro' which its principles, and in some degree its processes, might be taught, and our students retire to their homes from college, with a competent knowledge of its theory and an enlightened taste for its practice. This is the more necessary in our country, where so great a proportion of the students are of the agricultural character. Whether it would be better to detach this branch from the other sciences, and to make of it a separate institution, I am not prepared to say. The proposition is new and would require consideration."

Jefferson's ideas about a chair of agriculture at the University of Virginia were never realized. But within his century there was established the land-grant college system, which brought to full fruition the thoughts of Jefferson about agricultural education.

Jefferson's portrait rightly hangs in the land-grant colleges and universities today, and true to his philosophy students are trained not only in techniques but also in courses of broader import. Only by continuing such courses and broadening their basis, as is necessary in this complex and changing world, may we continue to have a generation of farming people who will maintain their standing and approach the Jeffersonian definition as "The chosen people of God, if ever he had a chosen people, in whose breasts he has made the peculiar deposits for substantial and genuine virtue — its focus in which keeps alive that sacred fire which otherwise might escape from the earth."

Land Drainage in England and Wales

(Continued from page 298)

Especially is this true in the Fen areas of eastern England which are below high tide and only slightly above mean sea level. A great part of the runoff there is pumped out; some is pumped twice before it reaches the sea. Some of the many plants are of huge size; one which has a capacity of 1,500 cfs consists of three units each with discharge pipe of 102 in diameter. In many parts of the country levees are being enlarged to give more certain protection against maximum floods, and training walls at estuaries are being extended farther into the sea to reduce sedimentation in the river outlets.

Dredging to provide greater discharge capacity and channel clearing to facilitate movement of flood flows are the principal activities on outlet drainage systems. Levee construction is usually included in the major systems especially along the lower reaches of main rivers. Bank revetment to prevent or reduce scour is necessary along many reaches of rivers.

Rehabilitation of farm drainage systems is the most important work in progress under the war program of the land drainage division. Tile installed during the nineteenth century have been obstructed for many years, and open ditches have become so obstructed with silt and debris that they are no longer adequate. Cleaning out the ditches often has caused old tile systems to become operative again. Construction of mole drains is a considerable part of the work.

Success of the Program. Land drainage in England and Wales is much more a government undertaking than it has been in the United States. Catchment areas are established in the discretion of the Ministry of Agriculture and Fisheries and have powers considerably exceeding those of drainage districts here. Definition of these areas according to drainage basin boundaries provides a logical basis for coordination of the drainage problems in each area. All real property within the catchment area, with occasional exceptions, contributes to the construction and maintenance of the main outlet and protection works. Government aid is given for the improvement of existing works or the construction of new works, 50 per cent for the tributary works and for farm drainage, and up to 75 per cent of the cost for "main rivers." The government has purchased drainage machinery, plows, and tractors for farm drainage, which are operated by county war agricultural executive committees, and the farmers may pay their share of the cost in installments.

As stated in the beginning, the cultivated acreage in England and Wales was increased by 60 per cent, 4.1 million acres, in three years. Without the government control provided by the Drainage Act of 1930 and subsequent agricultural acts and the government grants-in-aid which have amounted to more than 11 million pounds sterling, this degree of success could not have been obtained.

International Cooperation. In July and December 1941 the British government asked the United States for assistance in its land-drainage and agricultural war programs, specifically requesting hydraulic engineers to assist the Ministry's staff in planning land-drainage projects and in selecting lend-lease equipment, mostly powerful tracklaying tractors and tile-trenching machinery, to be obtained for use in reclaiming swamp areas and draining wet farm lands. The author was in England and Wales during March, April, and May 1942 to investigate these needs and to obtain first-hand information on Great Britain's program for land drainage in World War II. Some drainage equipment has been furnished the British government during recent months, and the U. S. Soil Conservation Service has had two drainage engineers in England since July 1942, who are working with British engineers on plans for drainage improvements that will result in bringing additional lands into cultivation. These engineers are planning to remain in Great Britain for the duration of the war.

Adapting Farm Machinery to Mulch Culture

By G. B. Nutt, W. N. McAdams, and T. C. Peele
MEMBER A.S.A.E. JUNIOR MEMBER A.S.A.E.

THE advantages of maintaining mulches on the soil surface where corn is grown were pointed out by Peele[1] from results obtained near Spartanburg, South Carolina, in 1941. On four soil types, air-dry material was added at the rate of 2½ tons oven-dry weight per acre to plots 0.01 acre in size. Corn yields were increased approximately 20 per cent by oat hay mulch and 80 per cent by crimson clover mulch. The increased yields were attributed to moisture conservation and plant food leached from the mulch.

In 1942 a cooperative project between the Soil Conservation Service (USDA) and the South Carolina Agricultural Experiment Station was established at Clemson with the following objectives:

1 To determine tillage practices suitable for the maintenance of plant residues on the soil surface during the growth of row crops, such as cotton and corn.

2 To test the adaptability of existing horse and tractor-drawn equipment in maintaining plant residues on the soil surface, and to design and develop tillage tools adapted to this purpose.

Eight runoff plots 1/15 acre in size were installed on an 8½ per cent slope to determine the effects of mulches on runoff and erosion. Eighteen additional plots of similar size were established on varying slopes for testing the efficiency of different cultural implements in controlling grass and weed growth while maintaining a mulch on the soil, and determining the effects of the treatments on crop yields. A supplementary area of several acres, sloping from 6 to 12 per cent, is being used to test equipment under conditions characteristic of the Piedmont soil province.

Fig. 1 View of clover balks before mulching operation

Tractor implements have been used principally to date, but some consideration has been given to horse-drawn implements.

A Model B Farmall tractor equipped with a B-96 planter, B-44 fertilizer attachment, and a B-236 cultivator was selected for use in this work. The manufacturer's representative, Wm. E. Meek, suggested the use of extra tool bars and heavy shanks for strengthening the front gangs of the cultivator, and supplied the rear section of a B-435 vegetable cultivator and various types and sizes of sweeps.

In 1942 conventional equipment for preparing the seedbed, planting, and cultivating was used in the growing of cotton on 42-in rows, and no problems were encountered. In September cover crops consisting of vetch and rye mixed or crimson clover were seeded on all the plots with the exception of two runoff plots.

In 1943 the plots were planted to corn with the organic matter from the cover crops handled in three different ways: plowed under, disked in, and maintained as a surface mulch. The supplementary field received similar treatments. The disking and plowing presented no machine problems, but on the plots where organic matter was left as a surface mulch, preparing a planting ridge was done with some difficulty. Cotton stalks had to be ripped out and narrow ridges formed without covering the vegetation in the middles. To do this various types and sizes of sweeps in combination with disk hillers were assembled on the front section of the B-236 cultivator. The most satisfactory arrangement consisted of using 6-in middlebuster bottoms set to run about 5 in deep with 14-in disk hillers mounted on the rear tool bar and spaced 22 in apart at

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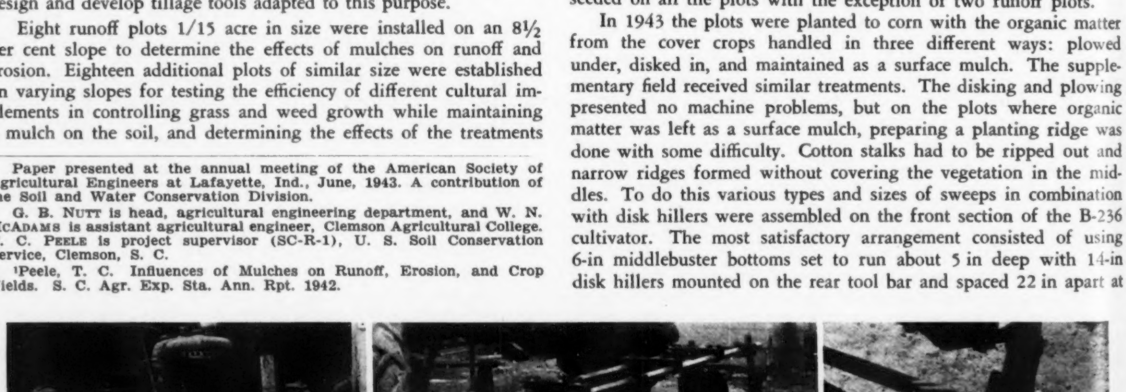
G. B. NUTT is head, agricultural engineering department, and W. N. McADAMS is assistant agricultural engineer, Clemson Agricultural College. T. C. PEELE is project supervisor (SC-R-1), U. S. Soil Conservation Service, Clemson, S. C.

[1]Peele, T. C. Influences of Mulches on Runoff, Erosion, and Crop Yields. S. C. Agr. Exp. Sta. Ann. Rpt. 1942.



Views of the equipment used in the South Carolina mulch culture research project. Fig. 2 Bedding attachment • Fig. 3 Vegetable cultivator with hillers and large sweeps • Fig. 4 Middlebuster point used in mulching operation • Fig. 5 Middlebuster point with flattened sides used in mulching operations • Fig. 6 Mulch plow constructed at Clemson, S. C. • Fig. 7 Mulch plow designed by J. T. McAlister

the proper angle for throwing up a ridge (Fig. 2). This operation left a 20-in balk of the cover crop in the middles. Some of the rye in the ridges failed to die, but the vetch and crimson clover were easily killed. Hereafter the planting ridge will be formed several weeks prior to planting. Thus in preparing the planting ridge conventional equipment strengthened with an extra tool bar is satisfactory.

In mulching the 20-in balk of undisturbed cover crops (Fig. 1) several difficulties were encountered. On the B-435 vegetable cultivator (Fig. 3) was assembled three heavy shanks and 20-in sweeps preceded by disk hillers set with just enough angle to cut through the vegetation and prevent clogging. On straight rows and easily tilled soil fair results were obtained, but in heavy, rocky soil the sweeps would not stay under the vegetation. In addition, the sweeps could not be kept in the middles when plowing around the curves on contoured rows, due to the fact that when the front end of the tractor is moved to the right or left the sweeps move in opposite directions, throwing them off their course. Machinery mounted in the rear of tractor wheels will be unsatisfactory for mulching the middles of rows having sharp contours.

A B-14 middlebuster (Fig. 4) with moldboards detached and frog cut down to which a 22-in special broadpoint share was attached gave much better results than the B-435 cultivator. However, some clogging occurred, some vegetation was not killed, and some was covered with soil.

Next, two inches of steel were welded to each side of a 20-in wide point special share, and the share flattened out. This 24-in sweep was then attached to the cut-down frog on the B-14 middlebuster and was some improvement over the preceding share, but continued to clog and cover some of the vegetation (Fig. 5).

A COMPLETE 26-IN MULCH ATTACHMENT WAS FINALLY DEVELOPED AND BOLTED TO THE BEAM OF THE MIDDLEBUSTER

Finally, a complete 26-in mulch attachment was developed and bolted to the beam of the B-14 middlebuster (Fig. 6). The upper bail bearing was replaced with one having a wide range of adjustments, and a 16-in plain blade special coulter was attached. This arrangement gave excellent results. To make the coulter cut through the heavy growth of vegetation and penetrate hard soil, it was necessary to operate it in a fixed rigid position. This placed extra strain on the coulter and rocks kept the blade dull and jagged. If this coulter can be designed to operate under spring tension, these difficulties may be eliminated.

Work with horse-drawn equipment has been limited to testing a mulch attachment for a horse-drawn plow which was developed in the Soil Conservation Service maintenance shop under the supervision of J. T. McAlister (Fig. 7). This implement has been tested under extreme conditions and was found unsatisfactory for use on curved rows and in rocky clay soil. On straight rows and light-textured soils, a horse-drawn implement of this type or a modification of it would probably do satisfactory work.

From the observations made during the short time this work has been under way, the following tentative conclusions have been reached regarding machinery used in the maintenance of plant residues on the surface of soils during the growth of row crops on terraced land in the Piedmont area:

1 Conventional implements may be modified and attachments developed for them, but they should be made heavier when they are redesigned for this specific work.

2 Mulching attachments should not follow the tractor wheels for use on sharply curved rows.

3 More power will be required than is obtainable with the Model B Farmall tractor if more than one row at a time is to be mulched.

4 The planting ridge should be prepared several weeks prior to planting, so that the vegetation will be decomposed and the ridge settled at planting time.

5 The limiting factor in adapting horse-drawn equipment to mulch culture is insufficient power.

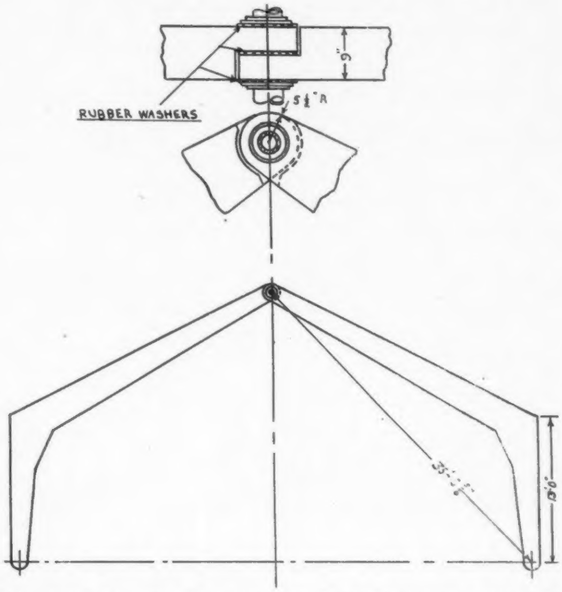
This paper is a progress report of work that is being continued.

For Barn Construction?

TO THE EDITOR:

AN article appeared in the London Engineering Journal for June 25, 1943, that I think would raise the eyebrows of some of your readers. It describes a new method of making concrete buildings, and it seems admirably adapted to barn construction.

The construction consists of an arched span similar to a hip roof barn. The roof trusses extend down the sides to the ground as shown in the accompanying sketch. The important thing is that



This sketch shows the Glover system of reinforced-concrete, portal-frame construction developed by C. W. Glover & Partners, consulting engineers of London, England

they are pinned where they join at the peaks; the bases sit in rounded pockets in the foundation. This permits the foundation to settle with no strain or cracking of the hip members.

The hip members are molded on the flat barn floor from one or more molds, and erected as soon as dry, which is 7 to 20 hours depending on the type of concrete used.

The shortage of steel forced the British into this construction. They have built over 140 such buildings with no record of failure.

J. B. FISHER

Chief engineer
Waukesha Motor Co.

Drainage for More Food

SOIL conservation has a very important place in our wartime food production program. In producing the increased crops demanded by the present emergency, there should be no wastage of our soil resources. All phases of soil conservation work are important in conserving the soil of American farms, but under the present emergency the improvement of drainage conditions on lands already under cultivation offers an immediate and effective method of increasing crop production without increasing the amount of agricultural labor and power and machinery required to produce the crop.

According to the records of the federal census bureau, there are approximately 21 million acres of land in organized drainage enterprises in the twelve southern states. Of this area approximately 5½ million acres that now are under cultivation require the rehabilitation of their drainage improvements before the land can be made to produce the crop yields its fertility warrants. The rehabilitation of the drainage improvements on this area is an effective method of obtaining increased crops.

Better Farm Buildings by Prefabrication

By Elmer F. Clark

MEMBER A.S.A.E.

THE construction of all types of prefabricated buildings by industry for Army, Navy, and civilian housing during the present war has developed many interesting details. The trend has been to obtain the maximum space with the smallest amount of material, a building easily erected, usable and portable. The allotment of materials by WPB and the necessity to economize on shipping space in cars and on ships have encouraged these developments.

These developments should be applied in so far as feasible to farm building even after the war. The excessive drain on steel, wood, and all other building products for war needs means that we must make the most economical use of materials after the war to meet the needs of construction on the farm as well as for urban and industrial building.

The point which is stressed by all manufacturers of prefabricated buildings is the unskilled labor and time required to erect the units. Labor is at a premium on the war fronts and on the home front and certainly prefabrication would not gain so much favor if it didn't actually save labor.

The designs used for prefabricated war buildings have been made to economize in the use of materials. Where a design or test indicates that a structural member can be reduced in size this is done. Even higher stresses were allowed in many cases in structures of the more temporary types, and they are proving satisfactory. This may prove even more possible as new lighter materials are developed with higher allowable stresses.

One type of building which is of interest to you is the one developed for the war program. This building is 22 ft wide, 48 ft long, and 11 ft in height at the center, and is made with a semicircular roof. The prefabricated sections are of light-gauge sheets 4 ft in width and approximately 12 ft in length. They are reinforced by a cold-formed rib which bolts directly into a corrugation on 4-ft centers. Nailing blocks fastened to the rib and cross pieces provide nailing facilities for insulation to the inside. A base angle allows the building to be erected on a foundation and secured by bolts. It is possible by the use of cold-formed channels to construct a wood floor, or a concrete floor can be used as an integral part of the foundation.

The building requires a minimum amount of materials. The semicircular section gives a 6-ft head room at a distance of one foot from the side wall. It is possible to use plastic windows made as an integral part of the roof sheet so that a maximum of light and sunshine can be provided in the building.

A building of this type offers a number of possibilities for the farmstead. The length is flexible, and different combinations for the provision of light, insulation, and ventilation make it possible to be used for several different purposes.

Suppose that a farmer buys such a building for a poultry house. The building is 70 ft in length. In a few years he decides to decrease his poultry flock and raise more hogs. By removing a few bolts he can dismantle 30 ft and move it in sections, and then purchase two new ends for a 22x30-ft hog house, or extend his former hog house of the same type without obtaining new ends for the needed space. There are so many cases on farms where changes in livestock production fail to make the maximum use of buildings and more flexibility is needed.

Steel is a material which readily lends itself to fabrication. The many machines added to steel fabricating plants to handle war contracts on an assembly line will facilitate good prefabricated buildings. New developments in brakes, presses, and dies are responsible for a more accurate or precision job of fabricating. The cold-forming machines and improvements in welding add to uses for steel.

The biggest problem we find in industry is to obtain the proper requirements for buildings. If government and state agencies, together with industry, can agree on a good set of requirements it would help a great deal for the farmer to obtain buildings which will more nearly meet his needs. These requirements set up by engineers, builders, farmers, and research men would have a good influence on future building.

I would like to summarize how prefabrication can help to secure better farm buildings:

1 Buildings can be fabricated to the point where the ordinary farm labor can erect them at minimum labor cost.

2 Materials can be used economically by buying the correct size for the least possible waste in fabrication.

3 Materials and designs can be such that fire and wind-resistant construction are built into the building which are a severe hazard on the American farm.

4 Insulation where needed is included in the fabricated units.

5 The proper designs for any necessary heating and ventilation can be worked into the building.

6 A building with a pleasing appearance and maximum flexibility can be obtained.

7 Facilities now available in steel plants which are doing war work can easily do an excellent job of prefabricating buildings.

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Lafayette, Ind., June, 1943. A contribution of the Farm Structures Division.

ELMER F. CLARK is agricultural engineer, Butler Mfg. Co.

Nazis in the Woodpile

AN A.S.A.E. member, J. D. Long, submits the following review of a book by Egon Glesinger bearing the above title (Bobbs-Merrill Co., Indianapolis. 1942. $2.00), as being of special interest and significance to readers of AGRICULTURAL ENGINEERING:

The author, whose family for generations were lumber manufacturers and forest owners in all parts of the former Austro-Hungary monarchy, graduated from the Rockefeller Foundation-financed Graduate Institute for International Studies in Geneva. Three years of study in many European capitols for his thesis analyzing world timber economics resulted in his appointment as secretary-general of the Comite' International du Bois, a position he has held since it was originated in 1932. The office which was formerly in Vienna and Paris is now maintained in Washington, D.C.

From the vantage point of this background and position he has written a surprising book, which understandably may be overdrawn or prejudiced in some viewpoints.

European developments in wood chemistry during the past decade are outlined. He answers, at least in part, the question of the material reserves and resources which have supplied the German armies by pointing out the renewable source of supply available to the Nazis. Through activities of the German Wood Trust, Hitler's "Thousand Year Reich" is to be the "Age of Wood". They have even given wood the surnam "universalrohstoff" — the material which will produce anything.

Research and manufacturing plants in five main categories supply the Nazi armies and are one of their main hopes for German domination in the postwar economy. Motor fuel and lubricants from wood distillation supply practically all civilian and agricultural needs, wood gas for civilian automobiles and tractors saving an estimated 300 million gallons of gasoline in 1942. Food and fodder for humans and livestock are compounded from the sugars and proteins secured by the hydrolization of wood. Cellulose and synthetic textile fibers from wood are in sufficient production to meet amply the clothing requirements of the German population and armies, though it is believed the scientists have not yet succeeded in rendering the fiber as resilient and thus as warm as wool.

There, as in the United States, war has emphasized the importance of wood as a structural material, and it serves for all civilian construction, for transportable army huts, for packing cases and crates, airplanes and other war uses. "Wooden iron" composed of veneers impregnated with synthetic resins and then compressed to three times the usual wood density can be molded and machined to shape and gives light-weight equipment parts of high structural and electrical strength. Chemical by-products, especially lignin which serves as a source of cheap plastics and promises much more as its possibilities gradually become established, indicate wood as a more important raw material source for chemical development than petroleum.

NEWS SECTION

Agricultural Engineers War Conference at New York

THE North Atlantic Section of the American Society of Agricultural Engineers will hold its usual yearly meeting—its "second war work conference"— at the Belmont-Plaza Hotel, New York City, September 27 and 28. To all agricultural engineers interested in the program to be presented, the Section extends a cordial invitation to attend this meeting.

The forenoon session of the first day, with Ray W. Carpenter presiding, will open with an introductory talk by Section Chairman Archie A. Stone. The remainder of the session will be devoted to a questions-and-answers symposium on government policies on farm equipment and building supplies. The panel of speakers selected includes George Krieger, director, farm equipment division, H. S. Pringle, chief, farm equipment repairs branch, and D. A. Milligan, consultant, WPB; David Meeker, chief, farm machinery and supplies section, C. L. Hamilton, chief, farm building supplies section, and L. L. Needler, chief, distribution of farm supplies, WFA, and A. A. Stone, chief, farm equipment section, OPA. Questions to be submitted to this panel will deal with production, distribution, procurement, prices, etc., of farm building materials, farm machinery, electrical equipment, and other supplies.

The usual Section dinner will be held at 12:30 p. m. of the first day, the feature of which will be an address by Dr. Copeland Smith of the National Association of Manufacturers.

The afternoon program of the first day, with Frank Hamlin presiding will deal with wartime problems of agriculture and its service industries. Speakers will include Earl Foster, executive secretary, New York Emergency Food Commission; James E. Walker, chairman, Pennsylvania USDA War Board; C. T. Whitaker, president, New England Farm Equipment Dealers Association, and A. H. Hemker, General Electric Company.

The evening of the first day will be given over to four concurrent round tables, covering farm structures, power and machinery, rural electrification, and soil and water conservation. J. L. Strahan will preside at the farm structures round table, the scheduled speakers for which include Wallace Ashby on wartime crop storage problems, J. F. Schaffhausen on problems dealing with the maintenance of farm structures, A. M. Goodman on postwar building problems, and J. R. Connel on uses of fiber pipe.

At this writing programs for the other round tables are incomplete.

The forenoon session of September 28, with B. P. Hess presiding, will be devoted to a program of general interest including a paper on the use of V-belts and pulleys by Henry A. Page, another on farm freezers (speaker to be selected), a discussion of soil conservation in wartime by H. J. Raths, an account of a state fire control program by J. R. Haswell, and finished off with a talk by Arthur W. Turner, President of the Society.

The afternoon program of the second day, at which A. V. Krewatch will preside, will be opened with a talk by W. C. Krueger on cooperation of agricultural engineers and other specialists on production problems, and this will be followed by a consideration of current college problems in agricultural engineering, for which R. U. Blasingame, H. W. Riley, and G. M. Foulkrod are the scheduled speakers. It is also expected that the session will feature a paper on dehydration. Frank J. Zink of the Farm Equipment Institute will discuss the problems and accomplishments of the farm equipment industry in wartime.

The following day, September 29, a conference of extension agricultural engineers is being called by S. P. Lyle of the USDA Extension Service to consider necessary corrections and changes in federal building plans for the northeast states. This is intended as a working conference; however, it is open to anyone interested in better farm buildings.

Meeting of Chicago Members

AT THE suggestion of President Arthur W. Turner of the American Society of Agricultural Engineers, a dinner meeting of members of the Society in Chicago and suburbs is being arranged for Monday evening, September 13th. The dinner is scheduled for 6:30 p. m. at the Top-of-the-Town Restaurant, 185 N. Wabash Ave., Chicago. Members of the Chicago area are urged to be present, and other members who happen to be in the vicinity at the time are cordially invited to attend.

The primary purpose of the meeting is to discuss the question of whether or not to organize a Chicago section of the society. If members of the group in attendance are in general agreement that it would be desirable to organize such a section, steps will be taken at the meeting toward formal organization.

A.S.A.E. Meetings Calendar

September 27 and 28 — North Atlantic Section, Belmont-Plaza Hotel, New York City.

December 6 to 8—Fall meeting, La Salle Hotel, Chicago, Illinois.

June 19 to 21 — Annual Meeting, Hotel Schroeder, Milwaukee, Wis.

S.A.E. National Tractor Meeting

WARTIME and postwar engineering needs in the tractor and farm machinery field will be discussed at the national tractor meeting of the Society of Automotive Engineers to be held September 23 and 24 at the Hotel Schroeder, Milwaukee, Wis. The program is sponsored by the Tractor and Farm Machinery Engineering Activity of S.A.E., of which George Krieger, S.A.E. vice-president, is chairman, and A. W. Lavers, is vice-chairman.

The forenoon program of September 23 will open with a paper entitled "Predicting Tractor Bearing Life," to be presented by John Borland of the Timken Roller Bearing Co., followed by formal discussions by B. W. Keese, Wisconsin Axle Division, Timken-Detroit Axle Co., and L. A. Bixby, Clark Equipment Co.

The afternoon session of September 23 will be given over to the subject "Postwar Fuels," the chief speaker being T. H. Risk of the Ethyl Corp.

At the forenoon session on September 24, E. F. Brunner of the Goodyear Tire & Rubber Co., will present a paper, entitled "Postwar Tires," followed by general discussion.

The afternoon session of September 24 will open with a report by Vice-Chairman A. W. Lavers on the activities of the S.A.E. Tractor War Emergency Committee. This will be followed by a paper by R. B. Schenck, of the Buick Motor Division of G.M.C., entitled "Special Addition Agent Steels," followed by general discussion.

The meeting will close with a dinner session on the evening of September 24, at which S.A.E. Vice-President George Krieger will preside. The toastmaster for the occasion will be J. B. Fisher of the Waukesha Motor Co.; the feature of the dinner will be an address by M. Lee Marshall, deputy administrator, War Food Administration, entitled "Wartime Farm Machinery and Food Production."

Personals of A.S.A.E. Members

Henry J. Barre has been appointed the new head of the agricultural engineering department at Purdue University, effective September 1st, and succeeds *William Aitkenhead,* who has served as head of the department for nearly thirty years. Professor Aitkenhead retires with the title of professor emeritus of agricultural engineering and will continue to engage in part-time teaching and research work.

Dr. Barre is a 1930 graduate in agricultural engineering from Kansas State College. He was awarded a doctor's degree at Iowa State College several years ago, and for the past five years has been in charge of the grain storage project conducted jointly by the farm structures research division of the U. S. Department of Agriculture and the agricultural engineering division of the Iowa Agricultural Experiment Station at Ames, Iowa.

Robert C. Burnette was recently transferred to the War Food Administration at Washington from the Office of Price Administration and is now chief of the machinery repair parts section, materials and facilities division, WFA. Previous to his transfer he was acting chief of the farm equipment and tractor section, machinery branch, OPA.

Keith Hinchcliff, assistant agricultural engineer, Mississippi State College, is one of the authors of Extension Circular No. 1[illegible] entitled "Successful Home Food Storage", recently issued.

Orson W. Israelsen, research professor of irrigation and drainage, Utah State Agricultural College, was selected by the committee on faculty research of that institution for the second annual faculty research lecture, which was delivered before the U.S.A.C. Faculty Association on March 10 of this year. The title of the paper presented is "Irrigation Science — the Foundation of Permanent Agriculture in Arid Regions." A limited number of copies of the lecture are available on request to Dr. Israelsen.

Wheeler McMillen, editor, Farm Journal, is one of a committee of nine outstanding magazine editors invited by Elmer Davis, director, Office of War Information, to advise the OWI on magazine problems.

I. D. Mayer, associate in agricultural engineering, Indiana Agricultural Experiment Station, is one of the authors of Bulletin 483, entitled "The Construction and Operation of an Experimental Dairy Barn," just issued.

C. B. Richey has recently taken a position with the Electric Wheel Co., Quincy, Ill., as development engineer, having resigned as assistant professor of agricultural engineering at Ohio State University.

George R. Shier resigned July 1 as extension agricultural engineer of Ohio State University, to become associated with Howard S. Sterner Co., consulting structural engineers of Columbus, Ohio. In his new connection, he will do consulting engineering work in the farm structures field, as well as engage in sales engineering.

Joseph W. Simons was recently assigned to the machinery repair parts section, materials and facilities division, War Food Administration, having been transferred from the farm structures research division, BPISAE, USDA.

L. J. Smith, in charge of the agricultural engineering section, Washington Agricultural Experiment Station, is one of the authors of Popular Bulletin No. 172, entitled "Home Drying of Fruits and Vegetables with the W.S.C. Dehydrator" recently issued.

G. E. Wenzloff has resigned his position in charge of the cane harvesting department of the United States Sugar Corporation, Clewiston, Florida, to become general manager of the Zellwood Drainage and Water Control District of Zellwood, Florida.

RESEARCH NOTES

(A.S.A.E. members and friends are invited to supply, for publication under this heading, brief news notes and reports on research activities of special agricultural engineering interest, whether of federal or state agencies or of manufacturing and service organizations. This may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Mich.)

Necrology

BENJAMIN O. CHILDS, associate agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture, passed away May 13 at his home in Montpelier, Vermont.

Mr. Childs was a native of the state of Georgia. He graduated from the Alabama Polytechnic Institute in 1907 with the degree of bachelor of science in civil engineering. Following graduation he entered the employ of the Louisville & Nashville Railroad Co., at Birmingham, Ala., as instrument man and chief of party, and in 1910 when he severed connections with this employer he was resident engineer of the maintenance of way department at Birmingham. Fram 1911 until 1917 he was engaged in the contracting business.

In May 1917 Mr. Childs joined the Army with a first lieutenant's commission and at the time of his discharge in 1920 he was a major in the ordnance department. He spent over 12 months in France acting as a division ordnance officer.

In December 1920 he was appointed county agricultural agent of Monroe County, Georgia, where he did an outstanding job in introducing dairying into the county which at that time had only one small dairy. He designed and constructed most of the concrete silos in the county and some 41 dairy barns. After resigning as county agent to go into the contracting business again, he continued for a period of three years to act in the capacity of engineering adviser to Monroe County.

In 1930 Mr. Childs entered the employ of the USDA Bureau of Public Roads, to take charge of a drainage experiment on sugar cane land at Houma, Louisiana, under the direction of S. H. McCrory. When the drainage division of the former Bureau of Agricultural Engineering was transferred to the Soil Conservation Service, Mr. Childs joined the latter agency and at the time of his passing was employed as associate agricultural engineer of the SCS in Vermont.

THE new ARMCO Aluminized Steel offers interesting possibilities for farm use after the war.

This unusual sheet metal combines the surface advantages of aluminum with the strength of steel. Its surface corrosion resistance is similar to that of aluminum—due to the formation of a tough, self-healing oxide film on the coating.

Aluminized Steel will not heat-discolor at temperatures up to about 1000° F., and will resist destructive oxidation at much higher temperatures. It may be painted; yet for most applications the natural surface is satisfactory. After the war it will be made in a finish that can be buffed to a bright luster.

The aluminum coating will not peel or flake in moderate drawing and forming. For structural designing, you can figure this metal has the same physical properties as its steel base. "Aluminized" can be supplied in either sheets or coils, with regular or high strength base metal.

Does this suggest to you possible future farm applications for Aluminized Steel? We shall be glad to work with you in carrying out your plans.

For technical data and other information, just address The American Rolling Mill Company, 2411 Curtis Street, Middletown, Ohio.

ALUMINIZED ARMCO STEEL

THE AMERICAN ROLLING MILL COMPANY

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, assistant chief, Office of Experiment Stations, U. S. Department of Agriculture. Copies of publications reviewed may be procured only from the publishers at the address indicated.

THE GRAVER CONTINUOUS CLARIFIER AT EWA PLANTATION COMPANY, *F. E. Gay.* Hawaii Sugar Technol. Rpts., 4 (1941). This clarifier operates upon basic principles entirely different from those of the standard lime-defecation processes heretofore practiced in Hawaii, namely, extremely low juice velocities throughout which prevent any redispersion of the formed floc and "upward sludge filtration" which allows the incoming juice to flow upward through a blanket of settlings that acts as a filtering medium by retaining fine nonsettling particles. The operating characteristics of the clarifier are analyzed, the nature of the device and its mode of operation are indicated in a diagrammatic drawing and in illustrative velocity of flow calculations, etc. A rate of handling of juice which would have been impossible with the intermittent-type settling tanks formerly used was attained, other improvements in processing were noted, and the finished sugars compared favorably with the best sugars produced in the Hawaiian Islands.

RECENT DEVELOPMENTS IN SUGAR CANE PLANTING AND RATOONING EQUIPMENT, *W. J. Maze.* Hawaii Sugar Technol. Rpts., 4 (1941). The author briefly summarizes planter development in Hawaii, beginning with a sled planter built about 22 years ago, one of the first successful machines and the first to furrow and drop the seed in one operation. The first wheel-mounted planter followed two years later. This machine had also a roller-covering device and a fertilizer distributor. Further developments are followed, including those of present-day machines. The history of ratooning equipment is similarly outlined. Use of ratooning equipment was formerly confined mostly to unirrigated areas, about the only equipment used in irrigated fields being 8-in walking plows and middle breakers for hilling up cane. A reversible shovel plow appeared about 1924, was widely used for a time, and was followed about 1930 by a line reshaper which has had a wide influence on ratoon operations on all irrigated and most unirrigated plantations. In 1927 a directly connected tool frame made possible the use of tractors for the various operations connected with mechanical ratooning. Ratooning machinery and practice, like the planting equipment, are followed through to the current devices and methods.

MISSOURI WOODS AND WOOD-USING INDUSTRIES, *W. C. Sechrist* and *R. H. Peck.* Missouri Ag. Exp. Sta. (Columbia) Bul. 442 (1942). Although Missouri uses five times as much lumber as is produced within the state, farmers and other small forest owners often are unable to dispose of homegrown forest products profitably owing to lack of information as to location of markets, species and specifications in demand, and prices available. The purpose of this survey is to provide marketing information to timber producers and to determine location of areas where present supplies of raw materials would appear to warrant establishment of new industries. Information was obtained from a total of 449 industries, including 150 sawmills and 38 stave mills. The two main topics taken up are uses of Missouri timber and commercial timber species and their uses, a directory of wood-using industries with the type of raw material used being included under the second of these headings. Examples of the questionnaires submitted to wood-using industries, sawmills, and landowners are appended.

DRAINAGE AND FLOOD-CONTROL ENGINEERING, *G. W. Pickels.* McGraw-Hill Book Co. (New York) (1941). In this second edition, about 95 pages of the original book have been replaced by 125 pages of new or revised material. In the chapter on precipitation, a table of data on fifty-four of the more important storms over the United States has been added, together with similar data for the New England storm of 1936 and the Ohio Valley storm of 1937, and other material has been added to this chapter. Also enlarged or brought up to date are the chapters on flood runoff, stream discharge measurements, flow of water in open channels (new data bearing upon Kutter's *n* both for stream channels and for floodways), and flood prevention by reservoirs. Only the chapter on drainage law remains unaltered.

GOOD PRACTICE IN CONCRETE MASONRY WALL CONSTRUCTION, *K. C. Tippy.* Jour. Amer. Concrete Inst. (Detroit, Mich.) 13 (1942), No. 4. The author discusses some of the details of concrete masonry wall construction, details which represent the difference between ordinary and good construction, as strength, durability, and watertightness; the need for preshrinkage of moisture-laden masonry units before laying in a wall; the use of the proper mortar; adequate footings and foundations; use of proper lintels and sills; tying of partitions to exterior walls; expansion and contraction joint; and precautions with parapet and flashings, drains, and waterproofing practice. *(Continued on page 314)*

Wars cannot be won without wood

DEMANDS for lumber and wood products increased when World War II got under way. Last year, 31.5 billion board feet of lumber was produced by the lumber industry. This vast supply was quickly used for drill halls and hangars, for airplanes, military huts, crates, and boxes, P.T. boats, plywood cargo planes and bombers, templates for shipyard designing, and housing for war plant workers.

Lumber, though limited in quantity, has also been put to vital work on farms. Long the most economical farm building material, lumber today is being used and re-used for needed items of farm equipment. Farmers are making or puchasing ready-made, lumber-built hog feeders, gates, hayracks, self-cleaning nests, waterers, roosts and stanchions. Such equipment is saving farm labor and feed. It is helping to maintain high levels of farm production.

Members of the Society are invited to write for a copy of the new 4-Square Lumber-Built Farm Equipment book which illustrates in detail many needed items of farm equipment. Working drawings accompany each illustration. Most of the items described may be built easily from available stocks of lumber.

WEYERHAEUSER SALES COMPANY • ST. PAUL, MINNESOTA

4-SQUARE LUMBER

Agricultural Engineering Digest

(*Continued from page 312*)

Proposed Specification for Cast Stone, *C. G. Walker et al.* Jour. Amer. Concrete Inst. (Detroit, Mich.) 13 (1942), No. 4. The principal changes which have been made are an increase in compressive strength requirements from 5,000 to 6,500 lb per sq in and a reduction in permissible absorption from 7 to 6 per cent. The absorption period has been increased from 24 to 48 hr, and the lower limit of 3 per cent on absorption has been eliminated.

The Effect of Change in Moisture Content of the Creep of Concrete Under a Sustained Load, *G. Pickett.* Jour. Amer. Concrete Inst. (Detroit, Mich.) 13 (1942), No. 4. The amount and rate of plastic flow in concrete under load has been found to depend upon the rate of drying. This paper presents a mathematical analysis showing that this is a natural consequence of nonuniform shrinkage and a nonlinear stress-creep relationship. The analysis further shows that shrinkage cannot account for additional creep unless inelastic strain not proportional to stress is produced. Results from experiments designed to test the applicability of the theory to concrete are reported.

Profile Curves for Open-Channel Flow, *D. F. Gunder.* (Colo. State Col.) Amer. Soc. Civ. Engin. (New York) Proc., 68 (1942), No. 4. The author analyzes certain irregularities appearing in the surface profile curves for gradually varied flow under conditions in which the depth of flow is less than both the normal and critical depths. The equation of gradually varied flow in a wide rectangular channel is integrated for the case in which the Chezy coefficient is given by the Manning relation $C = 1.486 R^{1/6}/n$. The curves for a variable Chezy coefficient given by the Manning relation are sketched. It is concluded, in part, that the use of the differential equation of gradually varied flow at depths below both the critical and normal depths should be restricted, in that the Manning relation for the Chezy coefficient should not be used, although in most cases, from a theoretical standpoint, the Bazin or Ganguillet-Kutter relations are satisfactory; and that "perhaps the backwater curves in most texts are based on certain qualitative features of the equation of gradually varied flow plus a knowledge on the part of the writers of what these curves should look like."

Agricultural Engineering Investigations by the New Jersey Stations. New Jersey Ag. Exp. Stas. (New Brunswick) Rpt. 1941. Current experimental results are reported in the form of brief answers to the following questions: Does silo leakage waste food material and what can be done about it, what determines silo pressures, are separate silo reinforcing schedules recommended for corn and grass silage, will silos hold more grass than corn silage, can condensation loading of dairy barn insulation be prevented, does it pay to irrigate potatoes in New Jersey, what is the New Jersey trend in crop irrigation, does tiling justify its cost and what system is recommended, how does New Jersey rank in rural electrification, what does the USDA Extension Service offer those having farm building problems, what paint types are best for farm structures in New Jersey, is assistance available in the adaptation or development of new machinery applications to farming, what is the cause of red water from wells and how can it be corrected, can polluted water be effectively sterilized by ultraviolet rays and made suitable for potable purposes, does the process of chemical treatment of sewage produce a sludge containing more plant nutrients than sludges from other processes, can the ash obtained from sewage sludge incinerators be used for commercial purposes, what are the sources of odor in sewage-treatment processes, how can the odors produced by stale sewage be controlled, can grease removal from sewage be accelerated, is chlorine effective in the control of bulking of activated sludge, can the oxidation of carbonaceous and nitrogenous materials in sewage proceed simultaneously, how can the operation of an activated sludge plant be better controlled, what service does this department give to the department of institutions and agencies, and what new structures or investigations with state institutions have shown the most progress in the past year?

Bonds for Rehabilitation

(*Continued from page 286*)

So restricted, such bonds might properly be issued in any amount up to the total of actual depletion and neglected maintenance and renewal. To this amount they should be tax-free; that is, amounts diverted into such bonds should be deductible from income for computation of taxes. No doubt there would be some difficulties of detail in determining the limit for such deduction and diversion, but the governing principles are well defined by years of usage.

New Literature

"THE 1943 BUYER'S GUIDE." Farm Implement News Co., 431 S. Dearborn St., Chicago.

This is volume 52 of the well-known farm equipment buyer's guide and implement repair directory covering products of manufacturers of farm and garden implements, tractors, wagons and carriages, motor trucks, lighting plants, cream separators, gasoline engines, windmills, pumps, wire fencing, and the many accessory lines sold by farm equipment dealers. This guide is issued annually and is divided into three main parts: (1) Various classifications of farm implements, tractors, vehicles, repairs, etc., with the name and address of producing manufacturers under each classification; (2) a general directory of manufacturers arranged alphabetically by states, with a listing of the products of each manufacturer, and (3) an alphabetical list of the names and addresses of manufacturers of farm equipment in the United States. An exhaustive index of the various equipment classifications is also provided.

"FARM TRACTORS — FUELS AND LUBRICANTS". Paper, 8½x11 inches, 80 pages, 182 illustrations. Standard Oil Company, 910 S. Michigan Ave., Chicago, Ill.

This book is designated as Engineering Bulletin No. FD-53 and is prepared by the sales technical service department of the Standard Oil Company for the special instruction of salesmen and users of farm tractors. The book is in two parts. Part one deals with the functions and construction of the various parts of the farm tractor, and part two with tractor operation and maintenance. A supplement to the book includes fuel recommendations for farm tractors and tractor data, adjustments, and lubrication recommendations intended for use where the instruction manual is not available. Anyone concerned with the sales, servicing, and use of farm tractors will find this book of inestimable value.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Robert J. Buzenberg, sales manager, farm machinery division, Viking Mfg. Co., Jackson, Mich.

Charles N. Karr, agricultural sales manager, The Cleveland Tractor Co. (Mail) 3137 Washington Blvd., Cleveland Heights 18, Ohio.

Keith Q. Kellicutt, civilian instructor, radio mechanics, Army Air Corps. (Mail) 9 S. Owen Dr., Madison, Wis.

Paul L. McConnie, tractor division, Eastern Sugar Associates. (Mail) P. O. Box 291, Central Juncos, Juncos, Puerto Rico.

Edward A. McRae, assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Harrison, Arkansas.

R. A. Mitchell, division manager, Hume-Love Co., P.O. Box 310, Mendota, Ill.

Dilman L. Moothart, assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) 63 S. 28th St., Paris, Tex.

Sadao Nagata, farmer, Sugar, Idaho.

Leonard D. Ogle, assistant sales manager, agricultural division, The Cleveland Tractor Co. (Mail) 897 Cambridge Rd., Cleveland Heights, Ohio.

Glen E. Page, engineer, Goodyear Aircraft Corp. (Mail) 736 H, Warner Ct., Akron, Ohio.

Richard L. Ranney, junior engineer, Forest Products Laboratory, U. S. Department of Agriculture. (Mail) McLean, Va.

Ephriam O. Schwab, assistant agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) P.O. Box 840, Corsicana, Tex.

Paul W. Silvey, advertising manager, Brower Mfg. Co., Quincy, Ill. (Mail) RR No. 2.

W. Forrest Smith, owner, Forrest Smith Terracing Co., Shelbyville, Ky.

J. Stefan, Jr., sales manager, Electric Wheel Co., Quincy, Ill. (Mail) 2300 Aldo Blvd.

E. Buford Williamson, junior agricultural engineer (BPISAE), U. S. Department of Agriculture. (Mail) P.O. Box 215, Leland, Miss.

TRANSFER OF GRADE

S. Milton Henderson, research assistant, agricultural engineering dept., Iowa State College, Ames, Iowa. (Junior Member to Member)

L. G. Samsel, supervisor, literature and film production, J. I. Case Co., Racine, Wis. (Associate to Member)

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